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Rev. 07/10/02

1077706

FIVE-YEAR REVIEW

FIRST FIVE-YEAR REVIEW REPORT

for

VERONA WELL FIELD
Battle Creek, Michigan

September 2002

Prepared by:

United States Environmental Protection Agency
Region 5
Chicago, Illinois

Approved by: Date:

Wm. E. Muno 9/30/02

William E. Muno, Director
Superfund Division, Region 5
United States Environmental Protection Agency

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Executive Summary

The remedies for the entire Site are protective in the short-term because there is no evidence that there is current significant exposure. In order for the remedy to remain protective in the long term, the following actions are needed, which are not already provided for in enforceable documents or agreements:

- implementation of measures to provide protection to the City water supply in case demand increases;
- incorporation of certain SVOCs and metals into the source area monitoring and cleanup requirements;
- implementation of screening-level sampling of source area soils for SVOC, pesticide/PCB, and metals contamination, and any significant risks from these parameters need to be addressed prior to release of control over these properties;
- implementation of actions to comply with 40 CFR 264.193 for the portion of the Annex force main going through the storm sewer.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name ***(from WasteLAN)*****:** **Verona Well Field**		
EPA ID ***(from WasteLAN)*****:** MID980793806		
Region: 5	**State: MI**	**City/County: City of Battle Creek, Calhoun County**
SITE STATUS		
NPL status: X Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction X Operating ☐ Complete		
Multiple OUs?* X YES ☐NO	**Construction completion date: _6 / _26 / 1997__**	
Has site been put into reuse? ☐ YES X NO		
REVIEW STATUS		
Lead agency: X EPA ☐ State ☐ Tribe ☐ Other Federal Agency		
Author name: Richard Boice		
Author title: Remedial Project Manager	**Author affiliation: U.S. EPA**	
Review period: 10 / 05 / 2001 to 09 / 30 / 2002		
Date(s) of site inspection: 08 / 27 / 2002; 3 / 8 / 2001		
Type of review: X Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: X 1 (first) ☐ 2 (second) ☐ 3 (third) ~~☐ Other (specify)~~		
Triggering action: ☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____ X Construction Completion ☐ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date ***(from WasteLAN)*****: 6 / 26 / 1997**		
Due date ***(five years after triggering action date)*****: 6 /26 / 2002**		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

1. It is possible that substantial breakthrough of VOC contaminated ground water will occur if the City water demand further increases. This will be addressed through an agreement among the State of Michigan, the City of Battle Creek and a PRP group. It is unclear what impact this breakthrough would have in the City water supply, but should not be considered an emergency situation because the VOC levels in the vicinity of the northern blocking wells only marginally exceed MCLs.

2. The ground-water extraction systems in the source areas need to be further evaluated and expanded to assure that the systems are capturing all source area ground-water contamination. This impacts the time for ground-water cleanup but not the protectiveness of the remedy because contamination lost from the source areas will be captured in the blocking well lines.

3. Based on a thorough review of available data by MDEQ, EPA and the PRPs, it was determined that certain SVOCs and metals in source area ground-water were either detected near Michigan soil criteria or lacked sufficient data. Therefore, the 2002 ESD provides for incorporation of these SVOCs and metals into the long-term ground-water monitoring and ground-water cleanup requirements for the affected source area. This action is necessary to ensure the protectiveness of the remedy.

4. It was determined that the RI screened out remedial actions to address SVOCs, pesticide/PCBs, and metals in source area soils based on from zero to two samples per source area. To address this deficiency, the 2002 ESD provides for conducting screening-level sampling for SVOCs, pesticides, PCBs and metals in source area soils. These results will be evaluated using Michigan soil criteria, and added to the more extensive soil sampling and ground-water monitoring if necessary. This action is necessary to ensure the protectiveness of the remedy.

5. Currently a single walled high density polyethylene pipeline is used to transport contaminated ground-water from the Annex to the air stripper. Part of this pipeline goes through a storm sewer. There is no way of detecting leaks of contaminated ground-water from the portion of the pipeline that goes through the storm sewer other than visually observing the discharge to the wetwell. This condition may not be protective of the environment because such leakage may have significant adverse impacts on aquatic life in the Battle Creek River. Compliance with the requirements in 40CFR263.193 is necessary to ensure that the remedy is protective of the environment.
Recommendations and Follow-up Actions:

1. Continue operation, maintenance, and monitoring of the dual blocking / Annex Paint Shop pump-and-treat system, and the TSRR pump-and-treat system until ground-water CUOs are achieved. For the dual blocking well/ Annex / Paint Shop system, this should continue to be conducted by the VWF Group with oversight by EPA and MDEQ. MDEQ now has full responsibility for operation, maintenance and monitoring at TSRR.

2. The agreement between the VWF Group, MDEQ and the City of Battle Creek is strongly supported by EPA. This agreement should be completed and implemented to provide protection to the City water supply up to City water pumping rate of 30 mgd and to improve hydraulic and chemical monitoring.

3. An expanded ground-water extraction systems for the Annex and for the Paint Shop should be designed and implemented to assure that source area ground-water is fully captured. The VWF Group is currently in the process of designing these improvements. After review and approval by EPA and MDEQ, they have agreed to construct and operate these expanded systems. The design is scheduled to be completed in 2002.

to be completed in 2002.

4. MDEQ should complete its evaluation of the pumping rate necessary to fully contain contaminated source area ground water at TSRR, and TSRR extraction system adjusted as necessary. This evaluation is now underway.

5. The 2002 ESD should be approved to incorporate the following requirements:
- adding certain SVOCs and metals into the long term monitoring and cleanup requirements in the source areas, and to provide a procedure to eliminate these requirements;
- soil sampling to screen for SVOC, pesticide/PCB, and metals contamination in the source areas, and providing procedures to evaluate the data;
- compliance with 40 CFR 264.193 for the Annex pipeline in order to ensure that release of VOCs to the Battle Creek River does not occur.

This ESD is expected to be approved in 2002. Subsequently, EPA will negotiate with the VWF Group to implement these measures.

6. MDEQ needs to evaluate whether TSRR soil meets RCRA clean-closure requirements and the revised CUOs proposed in the ESD for VOCs.

7. The VWF Group needs to implement the approved *Final Soil Verification Sampling Plan* (as amended as described above) to evaluate whether further soil treatment by SVE is necessary at the Annex and Paint Shop. This will be overseen by EPA and MDEQ and is scheduled to be completed within the next couple years

Protectiveness Statement(s):

The remedies for the entire Site are protective in the short-term because there is no evidence that there is current significant exposure. In order for the remedy to remain protective in the long term, the following actions are needed, which are not already provided for in enforceable documents or agreements:
- implementation of measures to provide protection to the City water supply in case demand increases;
- incorporation of certain SVOCs and metals into the source area monitoring and cleanup requirements;
- implementation of screening-level sampling of source area soils for SVOC, pesticide/PCB, and metals contamination, and any significant risks from these parameters need to be addressed prior to release of control over these properties;
- implementation of actions to comply with 40 CFR 264.193 for the portion of the Annex force main going through the storm sewer.

I. Introduction

This report presents the results of the initial Five-Year Review for the Verona Well Field (VWF) site (the Site) located in Battle Creek, Michigan. This review was performed by the United States Environmental Protection Agency (EPA). The following parties also provided input into the review:

- the Michigan Department of Environmental Quality (MDEQ);
- the City of Battle Creek;
- the Verona Well Field Group (VWF Group).[1]

The purpose of this review is to evaluate implementation and performance of the remedial actions in order to determine whether or not the remedy is or will be protective of human health and the environment.

The Agency is preparing this five-year review pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104]or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The agency interpreted this requirement further in the National Contingency Plan (NCP); 40 CFR §300.430(f)(4)(ii) states:

The remedial action that EPA selected for the Site is not expected to result in hazardous substances remaining above concentrations that would limit use and restrict exposure at the end of the remedial action. Therefore, a Five-Year Review is not required by statute.[2] However, because the remedial action requires more than five-

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[1] This is a group of private potentially responsible parties who are performing the remedial actions at the site in accordance with the requirements of Unilateral Administrative Orders issued by EPA. The VWF Group includes Grand Trunk and Western Railroad Company (Grand Trunk) and a group of generators.

[2] Section 121(c) of the Comprehensive Environmental Response Compensation and Liability Act, 42 U.S.C. § 9621 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and Section 300.430(f)(4)(ii) of the National Contingency Plan, requires periodic review (at least once every five years) for sites where hazardous substances, pollutants or contaminants will remain above levels that would allow unlimited use and unrestricted exposure after completion of the remedial action

years to complete, a five-year review is required by EPA policy.[3] It is EPA's policy to complete five-year reviews that are not required by statute within five-years of construction completion, as documented in the preliminary close out report.[4] The Preliminary Closeout Report for this site was issued on June 26, 1997, which makes June 26, 2002, the scheduled date for completion of the first Verona Well Field Five-Year Review. Work on this Five-Year Review was initiated on October 5, 2001. The Five-Year Review was completed on the date of signature shown on the title page.

This report will be placed in the Verona Well Field Administrative Record file located at EPA's office at 77 W. Jackson Boulevard, Chicago, Illinois, and in the local document repository, which is located at Willard Library, 7 West Van Buren, Battle Creek, Michigan.

II. Site Chronology

1930s: Home Fuel and Coal Company initiated operations at what is now referred to as the Thomas Solvent Raymond Road (TSRR), and Thomas Solvent Annex (Annex) source areas.

1950: The name was changed to Home Coal and Cleaning Solvent Company.

1950-1984: During this period, the Home Coal and Cleaning Solvent Company leased the property now known as the Thomas Solvent Annex (Annex) source area from the Grand Truck Western Railroad Company (Grand Trunk).

1964: The name was changed from Home Coal and Cleaning Solvent Company to Thomas Solvent Company.

1965: Grand Trunk employees began use of solvent degreasers at the Grand Trunk marshalling yard Paint Shop (Paint Shop).

1970-1980: An open pit was used for solvent disposal at Paint Shop.

1981-1982: 10 of the 30 VWF city water production wells, as well as 80 private residential wells were found to be contaminated by a number of volatile organic compounds (VOCs) including benzene, dichloroethanes, dichloroethylenes, methylene chloride, trichloroethylene (TCE), perchloroethylene (PCE or tetrachloroethylene), and vinyl chloride (VC). Up to 356 ug/l of total VOCs were detected in some City production

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[3] EPA 540-R-01-007, OSWER No. 9355.7-03B-P, Comprehensive Five-Year Review Guidance, June 2001, Section 1.2.2.

[4] EPA 540-R-01-007, Section 1.3.2.

wells, and nearly 1000 ug/l in some residential wells. The State of Michigan initiated study to identify causes.

1982-1984: EPA and MDEQ provided bottled water and portable showers to the residents with contaminated private wells. The City of Battle Creek adjusted pumping distribution, discharged water from some production wells to the Battle Creek River, and blended water from different wells to maintain an acceptable water supply. However, sampling showed that the VOC contamination was migrating further into the VWF, and by February 1984, contamination was found to have spread to 27 of the 30 production wells (see attached Figure 3-3 from the *Feasibility Study for the Interim Remedial Action*, CH2M-Hill). Residences and businesses with contaminated wells were connected to the City of Battle Creek water supply.

In July 1982, the Site was added to the National Priorities List. EPA conducted a ground-water investigation that identified the following three significant source areas: Thomas Solvent Raymond Road (TSRR); the Annex; and the Paint Shop. EPA sent notice letters to the source area owner/operators, including Thomas Solvent Company, and Grand Trunk. Grand Trunk also conducted ground-water investigations. EPA performed Phase I RI activities.

1984: EPA completed a Focused Feasibility Study for protection of the City water supply, and approved, designed, constructed and initiated operation of Initial Remedial Measures. Ground-water modeling for the system was performed for EPA by hydrogeologists from the United States Geological Survey (USGS). These initial measures, which are documented in a ROD, included conversion of 12 City-owned production wells (of which six were routinely operated) into blocking wells pumping at a combined total of 1700 gpm to protect the northern part of the VWF, and installation of three new production wells to replace lost City water production capacity. Initially the blocking well ground-water was treated with a liquid phase carbon adsorption system, which was replaced with an air stripper in September 1984. At the same time, the City of Battle Creek restricted usage of a number of the production wells closest to the blocking wells. By the end of 1984, 8 of the 10 production wells located north of the blocking well line were uncontaminated, and the other two showed only sporadic detections of 1 ug/l of various VOCs.

Meanwhile, nine leaking underground storage tanks were identified at the TSRR. Thomas Solvent Company removed a limited amount of non-aqueous phase liquid from the top of the ground-water aquifer and reportedly emptied underground storage tanks under an order from EPA. Thomas Solvent Company closed and filed for bankruptcy.

1984-December 1996: MDNR/MDEQ operated the blocking well system constructed in 1984, as the sole means of protecting the northern portion of the VWF, which provides the City of Battle Creek's water supply.

1985: EPA performed Phase II RI activities, prepared the Operable Unit Feasibility

Study for TSRR, and approved a ROD for TSRR. TSRR was the most highly contaminated source area. The ROD provides for conducting in-situ soil vapor extraction (SVE) and ground-water pump-and-treatment systems. USGS published a report on their investigation, including a ground-water flow model of the Site.

1986: A diesel oil spill was reported at Davis Oil, which is across the street and west of TSRR. Additional spills and leaks may have occurred since then, and free product is present as a light non-aqueous phase liquid (LNAPL) above the ground-water at this property.

1986-1987: EPA constructed the ground-water extraction system at TSRR, and initiated operation. The extracted ground-water was piped to the VWF air stripper for treatment. Part of the pipeline was constructed inside of a storm sewer.

1987-1888: EPA constructed the SVE system at TSRR, and initiated operation.

1987-1991: EPA performed the RI/FS for the final remedial actions.

1987 - May 6, 2002: Ground-water pump-and-treatment system is operating at TSRR.

1988-1992: The SVE system is operating at TSRR.

1989: EPA sent out information requests to generators associated with source areas.

1991: EPA executed a ROD for the final remedial actions. The selected remedial actions included construction and operation of a soil vapor extraction (SVE) system and ground-water pump-and-treat system at the Annex and Paint Shop, construction of a second line of blocking wells closer to the source areas (subsequently referred to as the southern blocking wells), operation of both blocking well lines, and construction of a separate ground-water treatment facility for TSRR. The ROD also provided for expanding the TSRR pump-and-treatment system to capture the downgradient plume. Meanwhile at TSRR, 21 underground storage tanks were removed, and air sparging tests conducted.

1992: EPA issued two UAOs to a group of generators and to Grand Trunk, requiring implementation of the 1991 ROD except the portion relating solely to TSRR. The generators and Grand Trunk agreed to implement the UAOs, and organized into the VWF Group for implementation of the UAOs. The TSRR remedial actions have been funded by EPA and MDEQ.

1993-1994: In 1993, the VWF Group constructed SVE systems at the Annex and at the Paint Shop, and operated systems from June 1993-June 1994, at which time VOCs were no longer detectable in the SVE air stream.

1993-1996: Subject to EPA review and approval, the VWF Group designed the system for the 1991 ROD remedy. The final RD/RA Design Report was dated September 26, 1994. Monitoring requirements were defined in a Ground-Water and Air Monitoring Plan (GWAMP) dated June 20, 1996. MDEQ did not review the final RD/RA Design Report and did not support the GWAMP.

1996: In May, EPA completed construction and initiated operation of a separate treatment system for the TSRR ground-water. In December, the VWF Group completed construction and initiated operation of the dual blocking well/Annex/ Paint Shop ground-water pump-and-treat system.

1996-present: The VWF Group has operated the dual blocking well / Annex / Paint Shop pump-and-treat system.

1997: After review of the first three months of monitoring data for the dual blocking / Annex / Paint Shop pump-and-treat system, EPA approved the Preliminary Closeout Report, in which EPA concluded that all construction had been completed in accordance with the EPA approved design. However, EPA also noted the following potential concerns: 1) hydraulic capture by the blocking well lines needed to be further evaluated; 2) source area ground-water capture had not been adequately demonstrated for the Annex; 3) it was possible that long-term-monitoring would demonstrate that the rate of ground-water clean-up in the Annex and Paint Shop source areas is too slow; 4) only preliminary soil sampling had been conducted at the Annex and Paint Shop following operation of the SVE systems; 5) MDEQ still had not determined whether SVE at TSRR had achieved the ROD clean-up objectives; and 6) it was possible that further construction would be required, most likely including additions to the blocking well system, the Annex extraction well system, and ground-water monitoring.

The City of Battle Creek constructed an iron/manganese removal facility having two infiltration ponds for disposal of water from filter backwash. Water infiltration from these ponds recharges the ground-water between the blocking well lines and, as a result, could impact performance of the blocking well system.

1998-present: In 1998, the City of Battle Creek sent letters to EPA expressing concerns about the effectiveness of the ground-water monitoring system, the pace of source area clean-up, and, most importantly, the need to provide protection at City water production rates than the dual blocking well system was designed to protect.[5] Since that date, numerous meetings have been held among the VWF Group, MDEQ, the City, and EPA to implement actions and develop formal agreements to address all parties' concerns

[5] The dual blocking well system was designed to prevent breakthrough of contamination at a City water production rate of 12.4 mgd (80% of the maximum daily pumping rate in 1993) using the City's 1993 pumping distribution. However, before the contamination from TSRR, the Annex, and the Paint Shop impacted the Verona Well Field, it has been estimated that the City's wells had the capability to produce 30 mgd.

about the remedies. As a result of cooperation among all parties, more extensive ground-water characterization and monitoring has been conducted. The VWF Group. MDEQ and the City are jointly developing a *Verona Well Field Management Plan* to improve the overall operation, maintenance, and monitoring of the remedial systems and better manage the common resource aquifers. The VWF Group and EPA are developing a formal enforceable agreement to address the remaining UAO requirements and resolve all remaining cost issues. Finally, the VWF Group and MDEQ are cooperating in development of a formal enforceable agreement to increase protection of the City's water supply as City water demand increases up to an average monthly production rate of 30 million gallons per day (mgd), and to enhance clean-up of the source area ground-water.

III. Background

The Site includes three source areas and the aquifer areas impacted by contamination from these source areas, which threaten the water supply for approximately 55,000 residents, as well as businesses and industries (see attached Figure 1 and Figure 2). The total area of ground-water contamination has covered over 160 acres, while each of the source areas covers only about one acre. The Site is located in the northeast corner of the City of Battle Creek, Calhoun County, Michigan. The area surrounding the Site includes residences and light and heavy industry. The approximate present boundaries of ground-water contamination are: Cotter Avenue on the east; TSRR and the Annex on the south; Pickford Avenue and the Battle Creek River on the west; and the northern blocking well line consisting of blocking wells V22, V24, V25, V26, V27 and V28 on the north (see attached Site Plan, Drawing Number 1, 1/18/2000, Progressive Engineering & Construction, Inc. (Progressive)). The Site is located in the alluvial valley of the Battle Creek River, which courses through the well field. Three aquifers are present at the Site, but they not separated by confining units: an unconsolidated aquifer consisting of poorly graded glaciofluvial sand deposits; an upper Marshall sandstone aquifer and a lower Marshall sandstone aquifer. The Marshall sandstone aquifers are fractured.

Three significant source areas were identified during investigations conducted in the early 1980s. Two of the source areas (TSRR and the Annex) resulted from operations of the Thomas Solvent Company, which operated in these areas from 1963 - 1984. Thomas Solvent Company purchased, stored, containerized, blended, transported, and sold virgin solvents, and transported, stored and arranged for disposal of spent solvents. Thomas Solvent company handled chlorinated and non-chlorinated solvents, as well as diesel fuel. The other source area (the Paint Shop) resulted from painting and maintenance operations of Grand Trunk Western Railroad Company (Grand Trunk). Solvents and paint thinners were used for cleaning and degreasing. These facilities are described briefly below:

- TSRR was the most highly contaminated source area. The facility included storage in and transfer operations from 21 underground storage tanks ranging in capacity from 4,000 to 15,000 gallons. Contamination of the soil and ground-water resulted from leaks in the underground storage tanks, leaking drums, and spills. Direct dumping onto the ground during drum and tank cleaning was also reported. Leak tests conducted in 1986, showed that 9 of the 21 storage tanks were leaking. At the start of the TSRR pump-and-treat system, total VOCs in ground-water were more than 100,000 ug/l, and recoverable amounts of LNAPL were present. The vadose-zone soil over much of the site was also highly contaminated with VOCs. Primary contaminants at TSRR were PCE, TCE, 1,1,1-trichloroethane, methylene chloride, acetone, methylethylketone, methylisobutylketone, toluene, ethylbenzene, and xylenes.
- the Annex included storage of solvent wastes in drums (prior to shipment to off-site recycling or disposal facilities), a loading dock for unloading of railway tank cars containing solvents, and two underground storage tanks for storage of virgin solvents. Contamination of the soil and ground-water resulted from leaking drums and surface spills. Direct dumping onto the ground during drum and tank cleaning was also reported. In 1989, ground-water at the Annex had total VOC levels as high as 49,800 ug/l, but no LNAPL was detected. The primary ground-water contaminants were vinyl chloride (VC), 1,2-dichloroethylene (1,2-DCE), TCE, PCE, toluene, ethylbenzene, and xylenes. Soil was contaminated primarily with PCE and TCE.
- the Paint Shop included a car-repair shop and car department building. Contamination resulted from disposal of the waste thinner and solvents by dumping onto the ground or into a drum pit (a 55-gallon barrel half buried in the ground with holes cut in the bottom and side to allow drainage of solvent). In 1989, up to 64,510 ug/l of total VOCs were detected in ground-water. The primary contaminants of concern were 1,2-DCE, 1,1,1-trichloroethane, PCE, 1,1,2,2-tetrachloroethane, ethylbenzene and xylenes. Soil was primarily contaminated with PCE, with a maximum detection of 35,000 ug/kg.

At all three source areas VOC contamination was concentrated in the vadose zone and the upper aquifer (the sand & gravel aquifer at TSRR and the Annex, and the upper sandstone at the Paint Shop). Downgradient from the TSRR and the Annex VOC contamination has been most highly concentrated in the upper sandstone aquifer, with lower concentrations detected in the lower sandstone aquifer. These contaminant plumes are captured by the southern blocking well line. Downgradient from the Paint Shop, the VOC contamination appears to remain in the shallow ground-water, which becomes the sand and gravel aquifer downgradient of the Paint Shop due to a dip in the bedrock surface. Modeling shows that under normal operating conditions the sand and gravel aquifer is likely to migrate around the northeastern end of southern blocking well line and be captured by the northern blocking well line.

Two gasoline stations that had leaking underground storage tanks or surface spills also present a risk to the VWF. These gasoline stations, which are owned and/or operated by Davis Oil Company, are being addressed by MDEQ's Storage Tank Division. One station is located west of the well field on Capitol Avenue, and could be a source of periodic low-level VOC detections in the City's Bailey Park production wells (see portion of the VWF west of the Battle Creek River on Figure 1). The other station is located across Raymond Road from TSRR (see Drawing 1 and Figure 9). This station presently has an LNAPL and contaminated ground-water. Some of the contaminated ground-water contamination from this facility is being drawn into the TSRR extraction system. Davis Oil is currently investigating ground-water contamination at this facility.

The Site remedial actions include clean-up of soils in the three source areas by SVE, clean-up of ground-water by pump-and-treatment, and protection of the City water supply using two lines of blocking wells designed to create two continuous lines of ground-water capture in three aquifers between the three contaminant source areas and the northern part of the VWF, where the City currently used production wells are located.

IV. Remedial Actions

Remedy Selection

1. Protection of the City of Battle Creek Water Supply:

1984 Initial Remedial Measures ROD: The 1984, Initial Remedial Measure ROD, provided for conversion of a number of City production wells into a blocking well system to protect the northern production wells, and installation of new City wells to restore six million gallons per day of the City water production capacity. These measures were "intended to stabilize conditions at the Verona Well Field until a final remedy is selected and implemented."

1991 Final ROD: The 1991, ROD requires that the dual blocking well system, "continue to limit groundwater contamination at the Verona Well Field production wells to levels that do not pose a health hazard" (p. 38 of ROD Summary). The ROD did not propose to completely prevent breakthrough of contaminants into the VWF. The FS anticipated that the dual blocking well system would be designed to prevent breakthrough of contamination at a City water pumping rate of 80% of the daily maximum pumping rate. The ROD also stated that: "it is EPA's policy not to provide for any future growth when designing remedial actions for Superfund sites"; and "any increase in pumping, or other actions, in the well field by the City that results in failure of the blocking wells to protect the well field will be the responsibility of the City" (see p. 12 of the Responsiveness Summary for the 1991 ROD).

1992 UAOs: The UAOs require that the southern blocking well system:

"shall be designed to provide complete capture of the contaminant plume from all three source areas. The system shall be designed as a network of interconnected wells designed to prevent contaminants from migrating around, under or between the wells."

The southern blocking well system should also prevent bypassing of the northern blocking well system to the west, which could result in contamination of the Bailey Park wells on the west side of the River, should provide additional overall protection to the VWF, and accelerate clean up of the portion of the aquifer between the blocking well lines. The UAOs also provided that ground-water modeling would be conducted for design of the dual blocking well system.

EPA Approved Design: The dual blocking well system was designed to fully capture the contaminant plumes from the three source areas at a City water production rate of 12.4 mgd based on modeling conducted by Geraghty & Miller, a consultant working for the VWF Group. Production at 12.4 mgd was 80% of the daily maximum City water production rate in 1989. Geraghty & Miller's model was a recalibrated and refined version of the original USGS model, which was prepared for EPA during the RI. During 2001, the monthly average City water production rate ranged from 9.0 to 14.7 mgd, and the daily pumping rate has ranged from 7.1 to 20.0 mgd.

Planned Changes: The VWF Group, MDEQ, and the City of Battle Creek have agreed to the joint development of a Verona Well Field Management Plan, which should provide for coordination of operation of the City production wells with the blocking well system. The VWF Group will also implement voluntary actions beyond the requirements of the ROD to assure protection of the City water supply at up to a monthly average water production rate of 30 mgd.[6] MDEQ and the VWF Group are drafting a document that incorporates this increased protection.

2. Source Area Ground-water Capture Zones:

1985 TSRR ROD: The 1985 ROD provided for capture of the portion of the TSRR plume outlined by the 100,000 ug/l VOC contour, as shown on the attached Figure 9 from the 1985 TSRR ROD.

1991 Final ROD: The 1991 ROD provided for capture of the TSRR downgradient plume, which generally included the livestock yard area, including the high VOC contamination at monitoring well CH139S. The 1991 ROD also provided for collection

[6] The maximum City production rate in 1959 was 26.7 mgd. The production wells had an estimated maximum pumping capacity of over 30 mgd before the contamination was encountered in the early 1980s.

and treatment of ground-water at the Annex and Paint Shop source areas.

1992 UAOs: The UAOs require that the pump-and-treatment systems at the Annex and Paint Shop contain ground-water within and immediately downgradient from the source areas, as defined in the FS (p. 9 of Scope of Work (SOW) for Paint Shop UAO, and p. 13 of SOW for Annex UAO). The FS provides for containment of ground-water from the Annex up to about 100 feet north of Emmett Street, and from the Paint Shop to 150 feet northeast of the bend in Burton Road (located just southeast of the source area). Page 3 of the Annex SOW states that a pump test should be conducted for the design.
EPA Approved Design: The TSRR design provided for construction of 9 extraction wells with a combined extraction rate of 400 gpm.

The Draft Final Remedial Design/Remedial Action Work Plans for the Paint Shop and the Annex (Geraghty & Miller, August 13, 1993, p. 1-12) stated that the Annex and Paint Shop ground-water treatment systems zones of influence would be designed to achieve the requirements of the UAOs.

For the Annex, the RD/RA Design Report dated September 26, 1994, provided for construction of two extraction wells (GMA-1D and GMA-2D) screened in the upper sandstone aquifer with a combined extraction rate of 90 gpm. However, the Report provided that if startup data indicated that the Annex upper sandstone extraction wells (GMA-1D and GMA-2D) were not influencing the sand and gravel aquifer, then extraction wells shallow wells (GMA-1S and GMA-2S) may be installed. [7]

For the Paint Shop, the RD/RA Design Report provided that a separate ground-water extraction system would not be installed. Instead, the northeastern-most new blocking wells would provide capture and clean-up of the source area ground-water.

3. Ground-water Clean-up:

1991-Final ROD, as revised by the 2002 ESD: The 1991 ROD identified the following general ground-water clean-up goal for development and evaluation of alternatives in the FS: "Reduce ground-water contamination in the entire aquifer to contaminant levels that meet State and Federal clean up standards for protecting human health and the environment." Site-specific clean-up objectives (CUOs) for prevalent VOCs in ground-water to be achieved by ground-water pump-and-treat were listed in Table 16 of the 1991 ROD. The ground-water CUO for each VOC was the lowest concentration among the following clean-up goals:

[7] *Annex Recovery System Preliminary Design Report*, Geraghty & Miller, October 15, 1993, advised the following procedure for evaluating capture at the Annex: taking water level measurements from 6 monitoring wells and 7 SVE wells during start-up of Annex extraction wells screened in the upper sandstone aquifer, and preparation of draw-down maps.

- a cancer risk goal equal to the concentration estimated to produce an incremental lifetime cancer risk of 1X 10^{-6} due to ingestion of drinking water in the residential scenario (called the Cancer Risk Goal in Table 16);
- a non-carcinogen risk goal equal to the concentration estimated to produce an exposure rate equal to the reference dose for health effects other than cancer due to ingestion of drinking water in the residential scenario (called the Non-Carcinogen Risk-Ratio Goal);
- the Safe Drinking Water Act, Maximum Contaminant Levels (MCLs);
- the Michigan Act 307, Type B ground-water clean-up criteria.

However, if any of the clean-up goals were less than the laboratory method detection limit (MDL), then the MDL became the CUO. The ground-water CUOs apply to the entire aquifer. Using similar procedures but updated standards, toxicological data, and exposure assumptions, the CUOs are being updated through an ESD (see Section V. of the draft ESD and the attached (DRAFT) ESD Table 1).

40 CFR 264.18(b) of RCRA and Executive Order 11988 are identified as ARARs in the 1991 ROD and require that the ground-water treatment system be above the 100-year flood plain.

4. Ground-Water Sampling and Monitoring:

Remedial Investigation (RI): A variety of investigation activities were performed between 1982 and 1989, including multiple ground-water sampling events and hydrogeological evaluations. The majority of the ground-water RI activities were conducted in 1983, 1984, 1987 and 1989 by CH2M-Hill, Inc. (CH2M-Hill) under contract to EPA. The soil assessment aspects of the RI activities are described below in Section 6.

Pre-Phase I RI activities (1982-1983) included assessment of potential sources of contamination, sampling of private drinking water wells, and City production wells. Phase I and Phase II activities were conducted in 1983-1985 and included: 1) ground-water sampling at 53 monitoring wells with all samples analyzed for VOCs, and samples from 22 of the 53 wells also analyzed for SVOCs; and 2) sampling from 27 city production wells and the City's water plant tap for VOCs. This included sampling 8 monitoring wells at the Annex, 10 at TSRR, and 2 at the Paint shop.

Additional investigations were performed between 1987 and 1988, including multiple rounds of ground-water sampling (February, March, April, May, August and September 1987) with all samples analyzed for VOCs, and some also analyzed for SVOCs.

The final RI ground-water investigations were performed in 1989, and included three rounds of sampling in March, April, and June 1989. Over 100 samples were collected during each sampling round. All samples were analyzed for VOCs. In addition, 8 samples from each sampling round were also analyzed for semivolatile organic compounds (SVOCs), and 4 samples from each sampling round were analyzed for the full hazardous substance list, including VOCs, SVOCs, pesticides, PCBs, metals and cyanide. For TSRR, 7 on-site, 3 upgradient, and 14 downgradient monitoring wells were sampled. For the Annex, 3 upgradient, 7 on-site, and 24 downgradient monitoring wells were sampled. For the Paint Shop 7 on-site wells were sampled, as well as some upgradient and downgradient wells. The Grand Trunk Roundhouse, a Consumers Power area, and the Raymond Road Landfill were also investigated, but were eliminated as sources of significant concern.

In addition, the final RI ground-water investigations included: geological logging; water level measurements; hydraulic conductivity testing; and vertical aquifer sampling of a number of monitoring wells with analyzes for select VOCs.

1991 ROD, 1992 UAOs: The 1991 ROD required that parameters listed in its Table 21 be analyzed every two years. The 1992 UAOs require that as a minimum ground-water monitoring shall include routine sampling for analysis of the VOCs listed in Table 16 of the ROD, and periodic sampling for analysis of EPA's full priority pollutant list of organic and inorganic parameters (pp. 6 and 13 of Annex Scope of Work, and pp. 4 and 11 of Paint Shop Scope of Work).

Design Development Sampling: In 1993, the VWF Group measured ground-water elevations from 120 wells and sampled over 70 wells for design purposes. This included 20 ground-water samples near the Annex, which were analyzed for VOCs.

2002 ESD: After extensive review of available data by MDEQ, EPA and the VWF Group, a revised list of parameters to be included in the long-term monitoring program has been defined in the draft ESD (see attached (DRAFT ESD Table 1). The ESD will also provide a procedure for eliminating the SVOC and metal parameters from the long-term monitoring program based on baseline source area and background ground-water sampling , and for adding SVOCs, pesticide/PCB, and metals based on results of source area soil screening sampling.

Long-Term Monitoring: The EPA-approved design for work by the VWF Group included a GWAMP, which defined monitoring requirements for the period of time after construction of the 1991 ROD remedy in December 1996. The GWAMP provided for hydraulic monitoring, sampling of sentinel wells located to detect breakthrough of contaminants through the blocking well lines, and sampling extraction and monitoring wells to help assess the pace of the clean-up. Although the 1991 ROD required sampling for Table 21 parameters every two years, the GWAMP provided for analysis of Table 21 compounds only every 5 years, and all other ground-water samples were only analyzed for VOCs. For TSRR, a Ground-water Monitoring Plan dated May 1996, was developed and included hydraulic and water quality monitoring of monitoring and extraction wells. This plan only required analyses of ground-water for VOCs.

The GWAMP and the TSRR ground-water monitoring plan will soon be superseded by a Long-Term Monitoring Plan (LTMP) being developed as a cooperative effort among the VWF Group, MDEQ, EPA and the City of Battle Creek. Like the GWAMP, the LTMP includes water quality sampling at sentinel wells to detect breakthrough and at monitoring wells and extraction wells to assess the pace of clean-up. However, the LTMP adds specifically designated sentinel wells downgradient from the Annex, TSRR and the southern blocking well line; and the sentinel wells for the northern blocking wells have been converted to monitor either the upper or lower sandstone aquifer rather than being screened across both aquifers. Under the LTMP, hydraulic monitoring using annual water level measurements will continue, but an attempt will be made to better assess containment of contaminants along the southern and northern blocking well lines by taking continuous water-level measurements from sets of three peizometers extending roughly perpendicular to the blocking well lines. The parameters list for the LTMP will be updated in accordance with the provisions of the 2002 ESD.

5. Soil Clean-up:

1991 ROD and 2002 ESD: The 1991 ROD identified the following general clean-up goals for development and evaluation of remedial alternative in the FS:

- reduce all soil contamination at the major source areas to levels with a hazard index of less than or equal to one for non-carcinogens, and to a total excess cancer risk of 1×10^{-6} for carcinogens;
- reduce all soil contamination at the major source areas to levels that will prevent ground-water from exceeding the CUOs.

Based on these goals, site specific CUOs for VOCs in source area soil were identified in Table 17 of the ROD to be reached by in-situ soil vapor extraction. The soil CUO for each parameter was the lowest concentration among the following clean-up goals:

- the concentration in soil estimated to produce an incremental lifetime cancer risk of 1×10^{-6} due to soil ingestion in the residential scenario (called the Cancer Risk Goal (Carcinogens) in Table 17);
- the concentration in soil estimated to produce an exposure rate equal to the reference dose for health effects other than cancer due to soil ingestion in the residential scenario (called the Risk-Ratio Goal (Non-carcinogens));
- the concentration in soil that may leach into ground-water at a concentration equal to the cancer risk goal for carcinogens, or equal to the MCL for non-carcinogens using a 20X dilution/attenuation factor (called the TCLP Estimate for Ground-water Protection); and
- the Michigan Act 307, Type B soil clean-up criteria.[8]

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[8] The Michigan Act 307 criteria was conservatively estimated to be a concentration in ug/kg in soil that may result in a ground-water concentration equal to the Michigan Type B ground-water clean-up

The latter two goals could be replaced with a comparison of the results of a leaching in accordance with Section 6 of Michigan Act 307 with the ground-water clean-up goals.

The CUOs are being updated through an ESD (see attached (DRAFT) ESD Table 1). The updated standards include using the Part 201 Generic Residential Drinking Water Protection criteria from Michigan Act 451 to replace the Michigan Act 307 Type B criteria.

The 1991 ROD identified the clean closure requirements as ARARs, including 40 CFR 264.111. 264.112, 264.113, 264.178 and 264.197, and determined that the remedy satisfies these ARARs. The 1991 ROD also identified the corrective action requirements in 40 CFR 264, Subpart F as ARARs, and determined that the remedy satisfies these ARARs.

6. Soil Sampling:

Remedial Investigation: A variety of investigation activities were performed between 1982 and 1989, including soil borings, soil sampling, soil classification, and a soil-gas survey. These activities were conducted in three phases (phase I, phase II and final) and were mostly performed by CH2M-Hill. The Phase I RI activities were conducted in 1983-1984 and included: i) soil borings at 37 locations; and ii) collection of soil samples at 20 of the 37 borings for analysis of VOCs and SVOCs. During Phase I, 61 soil boring samples were collected, including 24 soil at the Annex, and 29 at TSRR.

Phase II was conducted in 1984 and 1985 and included: 1) installation of 14 additional monitoring wells; and 2) collection of soil samples from 11 soil borings, at depths ranging from land surface to the water table, for analyses of VOCs and SVOCs; and iii) soil gas surveys at four different potential source areas. During Phase II, 7 soil borings samples were collected at TSRR, 2 at the Annex, and 4 at the Paint Shop.

Additional investigation activities were performed in 1987 and1988, including collection of soil samples at the Annex (31 samples), the Grand Trunk Roundhouse (22 samples), Consumers Power station (8 samples), and Paint Shop (9 samples), plus 10 locations representing background soil. The soil samples were collected at 3.5-4 feet below ground surface (bgs) except below the loading dock at the Annex where samples were collected at 0.5-1 foot bgs, and the Round House where samples were collected at 0-1 foot bgs. All samples were analyzed for target VOCs using a field gas chromatograph, and 10 selected samples were submitted to a laboratory for analysis of VOCs.

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criteria using a 20X dilution/attenuation factor.

The final RI sampling in 1989, included additional soil borings and collection of soil samples at depths ranging from land surface to the water table at the Annex (16 borings) and Paint shop (10 borings). A total of 43 soil samples were collected at the Annex, and 34 at the Paint Shop. All of the samples were analyzed for VOCs; 3 samples from each source area were also analyzed for SVOCs, and one sample from each site was also analyzed for pesticides, PCBs, and metals.

Design Development Sampling: In 1993, the VWF Group conducted 7 exploratory soil borings at the Annex and 2 at the Paint Shop. Soil samples from each boring were analyzed at two-foot intervals for VOCs using a portable gas chromatograph. One sample was selected from each boring for laboratory analyses for VOCs, and saturated soil samples from below the water table at two borings were analyzed for VOCs and SVOCs. In addition, soil samples were collected at 9 SVE well borings and 4 Paint Shop SVE borings and analyzed for VOCs.

Sampling to Assess Achievement of CUOs: After about four-years of SVE at TSRR in 1992, EPA conducted soil sampling to assess the effectiveness of the treatment. This included collection of more than 100 samples of vadose zone soils from 26 soil boring locations (each boring was sampled at 5 foot intervals from ground surface to the water table). All samples were analyzed only for VOCs.

In 1996, the VWF Group collected 9 soil samples at 3 borings in a hot-spot (based on previous sampling results) at the Annex to get an idea of the success of the in-situ soil vapor extraction. These samples were analyzed only for VOCs.

A *Final Soil Clean-up Verification Sampling Plan* (Progressive, January 2001) has been approved by EPA and MDEQ for evaluating the site-wide effectiveness of the soil treatment at the Annex and Paint Shop. At the Annex, generally this plan provides for collection of around 60 samples from 15 randomly selected soil boring locations and 5 directed locations (each boring will be sampled at 5 foot intervals from ground surface to the water table). At the Paint Shop, this plan generally provides for collection of around 84 samples from 14 randomly selected soil boring locations and 7 directed locations (again each boring will be sampled at 5 foot intervals from ground surface to water table). At both source areas, a soil sample will be collected from any stained soil (based on visual observation or FID readings) encountered in the randomly selected soil borings. At both source areas, all of the boring samples will be analyzed for VOCs, and one sample from half of the randomly selected boring locations will also be analyzed for naphthalene, and bis(2-ethylhexyl)phthalate. In addition, a group of metals will be analyzed on the sample collected from the sampling interval above the water table at the directed sampling locations.

The 2002 ESD will also add soil screening for metals, SVOCs, and pesticide/PCBs, and evaluating the results using criteria from a State of Michigan guidance document[9]. Results that exceed the criteria and background will be added to the statistical sampling in the *Final Soil Clean-up Verification Sampling Plan* for the Annex and Paint Shop. For TSRR, a separate statistical soil sampling event would have to be added.

7. Surface Water Protection:

1991 ROD and 1992 UAOs: The ROD and UAOs provide for treatment of the ground-water by air stripping prior to discharge to the Battle Creek River. ARARs identified in the ROD for the treated ground-water discharged to the Battle Creek River include Sections 304 and 402 of the Clean Water Act, State of Michigan Water Resources Commission Act 245, P.A. 1929, as amended.

Substantive Requirements Documents: Surface water discharge requirements including monitoring and limitations are identified in a number of substantive requirements documents (SRDs) issued by the MDEQ Surface Water Quality Division. All of these SRDs require periodic monitoring for a number of VOCs, and limit VOC discharge concentrations.

SRD MI004994 has been applicable to the discharge from the VWF treatment facility both when operated by MDEQ and by the VWF Group. The renewal for the VWF Group in 2001 included approval of an increase in the discharge rate from 4.4 to 7.8. This increased discharge rate reflects the ground-water extraction rate that is estimated to be necessary to prevent breakthrough of contaminants into the northern portion of the Verona Well Field at City production rates as high as 30 mgd (on a monthly average bases). This action is being taken in accordance with cooperative agreements among the VWF Group, MDEQ and the City (see Section V.1). The renewed SDR MI0042994 also approves discharge of the ground-water pumped from the northern blocking well line without treatment. MDEQ determined that ground-water from the northern blocking well line will meet the discharge limitations without treatment. This approval will free-up air stripper treatment capacity necessary to handle increased flows that may be necessary for containment of the Annex and Paint Shop, which is required pursuant to the UAOs.

Discharge of TSRR treated ground-water has been regulated by SRD MI0054241 both when operated by CH2M-Hill, Inc., and by MDEQ.

On August 20, 2001, MDEQ issued SRD NU0056081 for discharge of ground-water generated from a planned pump test at the Paint Shop, and a revised version of that permit was issued on March 28, 2002.

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[9] Part 201 Generic clean-up Criteria Tables, Operational Memorandum #18, June 7, 2000.

The VWF Group's usage of well cleaning reagents has been closely reviewed by MDEQ. July 26, 2000, MDEQ's Surface Water Division disapproved use of some well cleaning reagents requested by Progressive, the VWF Group's consultant. Progressive has followed up on this issue.

Annex Pipeline: TSRR, Annex and Paint Shop ground-water contain listed hazardous wastes. It is EPA's policy that ground-water containing listed hazardous wastes should comply with requirements for storage of hazardous waste under to the Resource Conservation and Recovery Act (RCRA). The draft 2002 ESD proposes that EPA determine that RCRA regulation, 40 CFR 264.193, be considered a relevant and appropriate requirement for the Verona Well Field remedial action. The regulation would require that the portion of the pipeline going through a storm sewer be replaced with a double-lined pipe with a leak detection system, or that a separate treatment system be installed at the Annex, unless a variance from these requirements is approved by the EPA Regional Administrator.

8. Air Protection:

1991 ROD and 1992 UAOs: The 1991 ROD provides for carbon adsorption treatment of the air discharge from air strippers used for ground-waters treatment. The air emissions from the in-situ soil vapor extraction systems at TSRR, the Annex, and the Paint Shop had to comply with ARARs. The UAOs require a technology that destroys the contaminants for treatment of SVE air emissions at the Annex and Paint Shop. ARARs identified in the 1991 ROD for the air discharge include the Michigan Air Pollution Control Act, P.A. 1965, as amended, and Michigan Act 348, which generally requires attainment of an excess cancer risk of 1×10^{-6} for air emissions, and 1% of the threshold limit value. In addition, best available control technology was required for new VOC emission sources.

Substantive Requirements Documents: MDEQ Air Quality Division issued an SRD dated October 1996, to provide monitoring requirements and discharge limitations for the emissions from the VWF air stripper being operated by the VWF Group. Quarterly sampling of the carbon system influent and effluent was required. This SRD was replaced by an updated SRD dated August 2, 2001, which did not change the discharge limitations, but included a determination by MDEQ that it was confident that the emission would comply with the SRD without treatment under current operating conditions. MDEQ provided that future changes to the remedy would have to be evaluated to determine any potential for increased contaminant loading, in which case the VWF Group would need to submit a request to the MDEQ, Air Quality Division.

9. Off-Site Disposal Protection:

The 1991 ROD determined that VOC contaminated ground-water and source area soils contained RCRA listed hazardous wastes. Therefore, off-site disposal of VOC contaminated ground-water or soil residuals must be in accordance with RCRA requirements for hazardous waste, pursuant to EPA's "contained-in policy".[10] Spent carbon that was sent off-site for regeneration had to be transported as a RCRA hazardous waste. In addition, the 1991 ROD determined that to comply with RCRA Land Disposal Restrictions, a notification of this determination must be provided to the facility for regeneration of spent carbon.

The UAOs required that condensate from the SVE system be disposed of in accordance with RCRA and other ARARs identified in the ROD.

MDEQ and EPA determined that soil residuals from well installation and sampling in source areas were required to be disposed of off-site if they contained listed hazardous wastes, otherwise the soils could be spread on the surface of the site. Soils from the source areas were assumed to contain hazardous wastes unless contaminants were less than State of Michigan Act 307 Type B criteria. In areas where listed hazardous waste disposal did not occur, the soils were to be handled as follows:

- placed back on the ground if contaminant concentrations were less than 20 times ROD ground-water criteria;
- disposed of in a municipal landfill if contaminant concentrations were greater than 20 times drinking water criteria, but less than concentrations that would make the soil a hazardous waste by characteristic;
- disposal in a RCRA hazardous waste landfill if the soils are hazardous by characteristic.

10. Site Cover, Access Restrictions, Deed Restrictions, and Institutional Controls :

No site cover is required. The 1992 UAOs require fences around the treatment equipment, and to prevent access to contaminated soils at the Annex and Paint Shop (except where fencing would interfere with operations at Grand Trunk). The fences must consist of a minimum 6-foot high chain link fence with three-strand barbed wire. Warning signs are required on all gates and on fence structure. Neither deed restrictions nor institutional controls are required in the ROD or UAOs.

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[10] For a description and other references explaining the contained-in policy see *Management of Remediation Waste Under RCRA*, EPA530-R-98-026, October 1998.

Remedy Implementation, System Operation and Operation and Maintenance

1. Quality Assurance/Quality Control of Data:

Remedial Investigation: Sampling and analyses for Phases I and II of the RI in 1983 - 1985 were conducted in accordance with procedures defined in EPA-approved sampling plans and a QAPP dated December 24, 1983. Procedures included collection of field blanks and duplicates, decontamination between each sampling point, and chain of custody procedures. All laboratory analyses were conducted through the EPA Contract Laboratory Program. EPA's Central Regional Laboratory conducted a Quality Assurance/Quality Control Review of the laboratory data. This review concluded that all the VOC data could be used quantitatively, but that the SVOC data collected during Phase I is only qualitative – that is the SVOC Compounds detected were present, but the concentrations reported may be unreliable, and compounds not identified may be present.

Sampling and analyses for the additional investigations in 1987-88 and for the final RI in 1989, were in conducted in accordance with EPA approved sampling plans, and a QAPP dated July 29, 1987. This included data validation by CH2M-Hill or by EPA Region 5's Central Regional Laboratory. All laboratory analyses were conducted through the EPA Contract Laboratory Program. All of the final RI data was determined to be usable quantitatively.

Some of the sampling procedures have been superseded since the time of the RI, including:

- to reduce analytical costs, TSRR soil boring samples for VOC analyses were composited. This may have resulted in loss of VOCs during sampling.[11]
- for ground-water, sampling low flow sampling using pumps instead of purging a specific number of well-volumes and then sampling by with a bailer.

TSRR Monitoring and Sampling: CH_2M-Hill operated the TSRR SVE system from 1987 – 1992, and also conducted a number of monitoring events for the ground-water extraction system. During the first ten months of operation in 1987, daily samples from TSRR extraction wells were collected and analyzed for VOCs. Subsequently through at least 1990 quarterly extraction well samples were collected and analyzed for VOCs. An interim ground-water monitoring well sampling event was conducted at TSRR in 1992.

During this period of time, sampling by CH_2M-Hill was in accordance with the July 29,

[11] A compositing procedure was also used for sampling soil borings at the Annex and Paint Shop. In this case, a coring tool was used to remove soil aliquots from three selected 6-inch brass split spoon sampler liners over the depth interval. These aliquots were placed directly into methanol to effect solvent extraction of the soil. A portion of the methanol was sent to the laboratory for analysis. This procedure should have minimized VOC loses.

1987 QAPP. CH_2M-Hill also operated the ground-water pump-and-treat system from 1996-1997. During this period, the May 1996 QAPP was used.

MDEQ operated the TSRR ground-water extraction system from 1987 - 1996, and the TSRR pump-and-treat system from December 1997 - present. MDEQ's ground-water sampling and analyses have been in accordance with standard MDEQ protocols.

Water discharge monitoring by MDEQ and by CH_2M-Hill were in accordance with the MDEQ Surface Water Division SRD. Air emission monitoring was in accordance with the MDEQ Air Quality Division SRD.

Dual Blocking Well, Annex and Paint Shop Monitoring and Sampling: All soil and ground-water sampling and analyses for design and monitoring by the VWF Group were conducted in accordance with an EPA-approved QAPP (Geraghty & Miller, October 1993 revision), as revised by subsequent EPA-approved submittals (such as one providing procedures for low-flow sampling of ground-water). The procedures included data validation. In addition, a *Final Soil Cleanup Verification Sampling Plan* and associated QAPP Addendum have been approved by EPA and MDEQ. These documents define soil sampling and analytical requirements to assess achievement of CUOs for soil at the Annex and Paint Shop. Water discharge monitoring by the VWF Group was in accordance with the MDEQ Surface Water Division SRD, and air emission monitoring was in accordance with the MDEQ Air Quality Division SRD.

Results from samples of City water production wells are also considered in evaluating the effectiveness of the remedy. These samples have been collected and analyzed by the City of Battle Creek in accordance with requirements of the Safe Drinking Water Act.

2. Construction Quality Assurance/Quality Control:

In the June 1997 Preliminary Closeout Report, EPA determined that the construction by EPA (original blocking well line, original VWF ground-water treatment system, TSRR ground-water extraction and treatment system, and TSRR SVE system) and by the VWF Group (SVE systems at the Annex and Paint Shop, and dual blocking well / Annex / Paint Shop pump-and-treat system, and monitoring upgrades) were consistent with ROD requirements and met the requirements of the EPA-approved designs.

It should be noted that the final construction of the dual blocking well / Annex / Paint Shop system included installation of 30 HP wet-well pumps instead of the 60 HP pumps specified. The wet-well pumps caused repeated shut-down problems due to seal failures especially during the first year of operation. Later the 30 HP pumps were replaced with 36 HP pumps with larger impellers and improved seal plates, which has greatly reduced the operational problems with these pumps.

3. Ground-water Monitoring:

Northern Blocking Well System from 1984 - 1996: As part of operation of the VWF remedy, MDNR/MDEQ routinely sampled the northern blocking wells and the treatment system, and collected water levels in the vicinity of the blocking wells and well field. During this period of time, data from City water production wells was also used to assess performance of the system, and to make adjustments to the blocking well extraction rates.

Dual Blocking Well /Annex / Paint Shop Pump-and-Treat System 1997-present: In 1997 and 1998, the VWF Group conducted hydraulic and water quality ground-water monitoring in accordance with the GWAMP and QAPP. MDEQ and the City of Battle Creek have expressed concern that the monitoring supplemented by interpretation using a ground-water model was not sufficient to detect/predict breakthrough. This included a MDEQ concern about contaminant breakthrough in the deep sandstone aquifer, which was largely unmonitored. MDEQ consistently insisted that containment of ground-water at the northern and southern blocking well lines, and the Annex and Paint Shop source areas must be proven using field data without reliance upon modeling for interpretation of the data. In addition, both EPA and MDEQ were concerned about ground-water containment at the Annex and Paint Shop. In an attempt to address these concerns, the following actions were taken:

- in 1997, the VWF Group installed another peizometer at the Annex;
- starting in 1998, the VWF Group, the City, MDEQ and EPA have conducted meetings to increase cooperation and information exchange among the parties;
- since 1998, the VWF Group, the City, and MDEQ have worked on a *Verona Well Field Management Plan* to coordinate operation and maintenance activities between the City water production system, and the dual blocking well system;
- in 1999, 2000, 2001 and 2002, the VWF Group conducted more extensive hydraulic and water quality sampling than required in the GWAMP;[12]
- in 1999, MDEQ installed and sampled 30 new monitoring wells, including nests in 8 locations (these monitoring wells were designed to detect breakthrough of contaminants through the northern and southern blocking well lines including via the deep sandstone aquifer);
- in 1999, the VWF Group installed a monitoring well screened in the deep aquifer downgradient from the Paint Shop.
- in 1999, USGS conducted flow measurements in the Battle Creek River to estimate the rate of River recharge to the ground-water aquifers in the vicinity of the VWF;

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[12] The 1999 annual sampling included water level measurements at 169 locations (with support from MDEQ and USGS staff) over a short period of time while the City pumping rate was kept constant (previously water level measurements were collected over an approximately two week period with no attempt to control the City production rate). in 2000, a shut-down/rebound aquifer test was conducted at the VWF (with support by MDEQ and USGS staff) by turning on and off the blocking wells while monitoring water levels in many monitoring and blocking wells

- in 1999, USGS conducted tracer tests to measure the rate of ground-water flow in the bedrock aquifers;
- in 1999, USGS conducted geophysical borehole logging to identify fractures and flow characteristics through fractures in the sandstone aquifers;
- in 1999, MDEQ used Geraghty & Miller's model to assess ground-water flow from the source areas;
- since 2000, USGS has continuously monitored water-levels in GM4, one of the sentinel wells for the northern blocking well line;
- in 2000, Arcadis Geraghty & Miller produced an updated model of the aquifers at the Site for the VWF Group;
- in 2002, the VWF Group conducted aquifer testing at the Annex and Paint Shop;
- in 2002, the VWF Group converted the 4 sentinel wells for the northern blocking well line from wells, which were open boreholes penetrating throughout the upper and lower sandstone aquifers, into three wells screened in the upper sandstone aquifer and one in the lower sandstone aquifers, and installed one additional sentinel well screened in the upper sandstone aquifer.
- in 2002, the VWF Group, MDEQ, the City and EPA are developing a Long Term Monitoring Plan.

Although MDEQ has been concerned that contaminant breakthrough would not be detectable using data from the sentinel wells, the attached Figures 30 – 33 from the *2001 Annual Monitoring Report* by Progressive strongly suggests that they can. These figures display VOC data from 1996 through 2000 in sentinel wells (GM3, GM4, GM5 and GM6), which are located north of the northern blocking wells. For example, the spike in VOC results in early 1997, corresponds to frequent system and blocking well shut-downs due to blocking well cleaning and start-up of the new system, and VOC increases in July 1999, corresponds to periods of extended down-times resulting from multiple electrical power failures from summer thunder storms and other electrical supply problems.

TSRR 1996-present: During its operation by CH_2M-Hill, TSRR ground-water monitoring well sampling was conducted in 4/96, 5/96, 6/96, 10/96, 1/97, and 5/97, in accordance with the requirements of the approved Ground-water Monitoring Plan and QAPP. Samples were analyzed for VOCs. MDEQ has conducted extraction well sampling quarterly, and conducted sampling of a somewhat expanded list of monitoring wells in July 1999, July 2000, and July 2001.

4. Protection of the City of Battle Creek Water Supply :

Initial Success: The blocking well systems have been successful in protecting the City of Battle Creek's water supply. Initially 12 former City production wells were converted into blocking wells. Six of these blocking wells now form the northern blocking well line. The total ground-water extraction rate was initially approximately 1700 gpm, but was later reduced to about 1450 gpm. As described in the chronology, by the end of 1984, 8 of the 10 production wells located north of the blocking well line were uncontaminated, and the other two had only sporadic VOC detections of 1 ug/l. The effectiveness of the clean-up of production wells north of the blocking well line is indicated by the attached Figures 2-2 and 2-3 from *Work Plan Verona Well Field*, CH_2M-Hill, November 8, 1988.

Loss of City Water Production Capacity: Before the contamination event, the VWF contained 30 usable production wells. Of these original production wells, only five are now routinely used, and eight are used on a limited basis because of their proximity to the blocking wells. Since 1984, the City has added twelve new production wells, three of which were installed by EPA in 1984. The City has cooperated in the remedial effort by concentrating its new production capacity in the northern part of the well field to reduce interference with the blocking wells.

Design of the Dual Blocking Well System: To design the dual blocking well system, Geraghty & Miller updated and refined the USGS model that was used for design of the original (interim remedy) blocking well system. The dual blocking well system was designed to capture all contaminated ground-water at a City water production rate of 12.4 mgd assuming the City utilizes the pumping distribution used during the summer of 1992 (this included less than 1% pumping from restricted use wells, which are near the blocking well system). The production rate of 12.4 mgd is 80% of the daily maximum pumping rate in 1989. The design was also checked to make sure it was protective when the restricted use wells were used to generate as much as 5% of the water production. Geraghty & Miller used the model to propose normal operating pumping rates of 935 gpm for the northern blocking well line, and 1675 gpm for the southern blocking well line. The Final RD/RA Design Report (Maumee Bay Environmental, September 26, 1994) proposed maximum operating rates, which served as the basis for well pump selection and piping design. The system was constructed in 1996. The VWF Group was able to use the existing air stripper to treat all of the ground-water from the dual blocking well system and the Annex (as opposed to separate ground-water treatment systems for the southern blocking wells, Annex and Paint Shop, as contemplated in the FS evaluation). However, this design provided very little flexibility to increase ground-water extraction rates because the air stripper was very near its maximum capacity.

Operational Difficulties and Responses: During the first couple years of operation of the dual blocking well / Annex / Paint Shop pump-and-treat system, the VWF Group had trouble with frequent down-times caused by wet-well pump seal leaks, power failures and other problems, and as a result did not maintain the design ground-water extraction rates on a consistent basis. This may have resulted in some contaminant breakthrough at the northern blocking well line. In addition, frequently reduced wet-well pumping capacity was addressed by turning off the southern blocking well line. Since that time, down-times have been reduced substantially, and extraction rates near the design rates have been consistently achieved. Efforts to reduce down-times have included:

- rebuilding and later replacing wet well pumps;
- adding a spare wet well pump;
- instituting a program for extraction well testing and cleaning;
- installing auto dialers at the pump houses for the Annex and the southern blocking wells to accelerate responses to problems with individual extraction wells;
- installing visual and audio alarms at the City water department control room to accelerate notification of problems.

These actions were in addition to routine maintenance and response procedures in the *Operation and Maintenance Manual* (Arcadis Geraghty & Miller, October 1998, as revised by Progressive in 2000). Starting in 1999, the VWF Group also increased the pumping rates at three northern blocking wells by around 100 gpm during May - August to lessen the potential for breakthrough during this period of high City water pumping. As a result of these efforts, the dual blocking well / Annex / Paint Shop pump-and-treat system achieved an uptime percentage of 96.6% in 2000 and 96.8% in 2001; and an average ground-water extraction rate as a percentage of the system design rate of 103.3% in 2000 and 103.7% in 2001. The northern blocking wells by themselves achieved an uptime percentage of 97.1% in 2000 and 99.1% in 2001, and an average extraction rate as a percentage of the design rate of 107.6% in 2000 and 110.2% in 2001.

<u>Assessment of the Dual Blocking Well System's Effectiveness in Capturing Upgradient Contamination</u>: Periodic low level VOC detections in sentinel wells and a few of the nearest City production wells, which have occurred ever since the interim remedy was initiated, have raised concern that the dual blocking well system is not completely capturing the contaminant plume. Because of the complexity of the flow system in the Verona Well Field,[13] the extensive additional investigation conducted in 1999, 2000, and 2001 could not determine whether or not the dual blocking well system captured all upgradient ground-water contamination from the source areas.

However, some of the additional information has been encouraging. One important result was that only low concentrations of VOCs were detected in the new deep sandstone aquifer monitoring wells. This result has dispelled concern about significant breakthrough occurring through the deep sandstone aquifer. Another encouraging result is that VOC detections in the sentinel wells for the northern blocking well line and the nearest City production wells have gradually decreased since 1996 (see attached Table H1 from the *2000 Annual Monitoring Report* for detections in City production

[13] Three aquifers are present at the Verona Well Field: a sand and gravel aquifer, a shallow sandstone aquifer, and a deep sandstone aquifer. The upper and lower sandstone aquifers are fractured and are very productive.

wells V13, V15, V17 and V36[14], and Figures 30 – 33 from the *2001 Annual Monitoring Report* for detections in sentinel wells GM3, GM4, GM5 and GM6). It is possible these reduced detections are a result of the reduced down-times and higher extraction rates of the dual blocking well system since 1996. However, it should be noted that VOC detects are reported to have increased in the sentinel wells in 2002. The shut-down rebound test in 2000, produced encouraging results by demonstrating that the northern blocking wells produce a substantial draw-down cone. In addition, USGS determined that the recharge of the Battle Creek River to the aquifer was more than previously estimated, which indicates that stress on the aquifer from the City water pumping was less than previously predicted in Geraghty & Miller's model.

On the other hand, the effectiveness of the blocking well system may be reduced due to recharge of shallow ground-water from two infiltration ponds constructed between the blocking well lines for the City's iron/manganese removal plant in 1997.[15] This and other new information was input into the new model prepared by Arcadis Geraghty & Miller. The model results indicate that the existing dual blocking well system is likely to be very effective up to a City water production of about 17 mgd, which is well above the 12.4 mgd rate used for the EPA-approved design. Breakthrough is predicted through both the northern and southern blocking well lines at a City water production rate of 18 mgd. The City water production rate periodically exceeds the 12.4 mgd rate that the dual blocking well system was designed to protect, and even the 17 mgd for which the system should be protective based on more recent modeling. Therefore, it is probable that breakthrough of low-level VOC contamination occurs during periods of high City water production.[16]

Significance of Breakthrough: The health risks resulting from breakthrough of contamination was a very serious concern when the blocking well system initiated operation in 1984, when total VOC levels in some of the City production wells exceeded 100 ug/l. However, at this time, breakthrough should not be considered an emergency situation because VOC levels in the vicinity of the northern blocking well line decreased to at most a few multiples of the MCLs. In 2001, samples from all of the northern

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[14] Production wells V13, V15, V17 and V36 are seldom used and cis-1,2-dichloroethylene (Bis) and 1,1-dichloroethane (1,1-DCA) are no longer considered carcinogenic (Region 9 Preliminary Remediation Goals are 61 ug/l and 810 ug/l, respectively). Therefore, the trace-level detections identified in Table H1 do not indicate a health risk.

[15] These ponds are for storage of filter backwash from the City's iron/ manganese removal system. It has been estimated that this system adds 175,000 gallons of water per backwash event, with one to three backwash events per day. Any of this water that infiltrates into the ground-water can reduce the ground-water capture zone of the blocking well system.

[16] The monthly average water production rate has exceeded 17 mgd during a few months since the dual blocking well / Annex / Paint Shop pump-and-treat system started operating in December 1996. During 2001, the monthly average City water production rate ranged from 9.0 to 14.7 mgd, and the daily production rate has ranged from 7.1 to 20.0 mgd.

blocking wells except V-27 met EPA's Maximum Contaminant Levels (MCLs) for protection of drinking water.[17]

Protecting the City Water Supply for Higher City Water Production Rates: The City of Battle Creek has informed EPA that they have studied other options for production of water and determined that expanded use of the VWF is the City's only viable source of water at the production and quality levels necessary to satisfy customer demands. Therefore, the City has emphasized that it needs protection of the City water supply at pumping rates equal to the water pumping capacity of the City production wells in place at the time that the contamination was discovered. In agreements with the City and MDEQ, the VWF Group has agreed to provide protection of City production up to 30 mgd.

5. Ground-water Containment in the TSRR Area:

Early Operations: CH_2M-Hill constructed and started-up the TSRR ground-water extraction system in 1987. MDEQ operated the system from 1989 -1996. CH_2M-Hill constructed a separate treatment system for TSRR ground-water in 1996, and operated the pump-and-treatment system in 1996 -1997. MDEQ has operated the pump-and-treatment system from December 1997 - present.

Initially the TSRR system included 9 ground-water extraction wells pumping approximately 350 gpm. The extraction well near W16S could not produce more than 5-7 gpm and was shut-down within a couple years. This may not be significant because a flow-line analyses and model calculations conducted in 1996 when the pumping rate was reported to be 250-300 gpm estimated that the capture zone extended 300 feet downgradient and 450 feet side-to-side (Final Current Conditions, CH2M-Hill), which appears to comfortably included the W16S area where VOCs exceeded 10,000 ug/l during the RI.

Some more recent capture zone evaluations appear to confirm that the formerly highly contaminated ground-water at W16S was drawn into the TSRR extraction system. In the 2000 Annual Performance Monitoring Report for Thomas Solvent Raymond Road Source Area, MDEQ conducted a capture zone evaluation that demonstrated that at a cumulative extraction rate of 160 gpm ground-water below the entire TSRR source area property and much of the Davis Oil property located west of the source area was within the capture zone. In addition, water levels collected at Davis Oil Company in 2001, when TSRR was operating at a much reduced extraction rate, appear to indicate that ground-water below the entire Davis Oil property extending as far as monitoring well W16S was being drawn into the TSRR extraction system. On the other hand, 100s of ug/l of VOC detected on TSRR were detected in a sample from a temporary monitoring well at the downgradient boundary of TSRR, which raises the question of whether contaminants are being lost from TSRR source area.

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[17] 5.2 ug/l of PCE was detected in V-27 compared to the MCL of 5 ug/l.

The 1991 ROD provided for expansion of the TSRR extraction system to capture highly contaminated ground-water detected in CH139S in 1989. This was never implemented probably because sampling conducted in December 1992, indicated that VOC concentrations in CH139S had decreased by a couple orders of magnitude from as high as 22,300 ug/l in 1989 to 330 ug/l in 1992. W16S is now clean and VOC concentrations in CH139S decreased to 83 ug/l in 2000; so it is no longer worthwhile extracting ground-water in these areas. However, in the past highly contaminated ground-water migrated north towards the blocking wells instead of being extracted using a source area pump-and-treat system as was provided for in the 1991 ROD.

Ongoing Operations: The TSRR ground-water pump-and-treatment system is currently designed to extract 300 gpm (some extraction wells have been turned-off because they are cleaned up), but MDEQ is re-evaluating the extraction rates. The capture zone evaluation conducted by MDEQ as presented in the *2000 Performance Monitoring Report for Thomas Solvent Raymond Road Source Area* appears to indicate that the system achieves adequate capture even at cumulative extraction rates of 160 gpm. The system experiences iron fouling problems with the extraction wells, air stripper packing material, and effluent discharge line. Extraction wells, packing material, and discharge line are inspected and periodically cleaned based on performance. Between 1997 and June 2001, the extraction rate at TSRR gradually decreased to as low as about 130 gpm due to restrictions in the discharge line. To address this problem, MDEQ installed a temporary discharge line in June 2001, and increased the extraction rates to 150-200 gpm until the discharge line was permanently replaced. MDEQ installed a permanent replacement discharge line in May 2002 and is now operating the system at about 220 gpm. Based on its evaluation, MDEQ has concluded that the source area contamination is contained using an extraction rate of 220 gpm. This conclusion may need to be reassessed in consideration of VOC detections in March 2002 at a temporary well at the downgradient boundary of the Site and in Davis Oil monitoring wells.

6. Ground-water Containment at the Annex and Paint Shop:

Comparison of EPA-Approved Design to FS: The EPA approved design provides for containment and clean-up of Annex ground-water, by initial installation of two extraction wells screened in the upper sandstone and pumping at a total rate of about 90 gpm, with a contingency to add extraction wells screened in the shallow ground-water if start-up data indicated that the upper sandstone extraction wells were not influencing the sand-and-gravel monitoring wells. The two initial extraction wells are screened in the upper sandstone aquifer even though most of the contamination is in the sand-and-gravel aquifer because hydraulic conductivity test results for the sand-and-gravel aquifer at the Annex were low, and because it was believed that the sand-and-gravel aquifer was hydraulically well-connected to the upper sandstone aquifer. In comparison, the FS anticipated use of 6 on-site extraction wells pumping at an aggregate of 400 gpm.

The EPA approved design provides for containment and clean-up of the Paint Shop VOC contamination using the two northeastern most southern blocking wells (GMBW1 and GMBW2). GMBW1 and GMBW2 are about 1000 feet downgradient from the Paint Shop source area, and at the property boundary between the Grand Trunk railroad lines and the City well field. GMBW1 and GMBW2 pump at an aggregate rate of 445 gpm. In comparison, the FS anticipated that 4 on-site extraction wells pumping at an aggregate rate of 400 gpm would be used for containment and clean-up of the Paint Shop ground-water.

Annex Monitoring: Construction of the Annex extraction system was completed and operation started in December 1996. Although the EPA approved design indicated that the assessment of the need for addition of shallow extraction wells would be conducted during start-up, in fact there was little attention paid to assessment of ground-water capture at the Annex during start-up. As a result this assessment has been a prolonged process. The first quarter water level measurement data at the Annex did not clearly indicate whether the sand and gravel aquifer at the Annex was being contained. To address this concern, a number of peizometers for the SVE system were added to the water-level monitoring events, and another peizometer was added at the downgradient edge of the Annex. The December 1997, water level measurements suggested that the sand and gravel aquifer was being contained, but subsequent water level measurements have been inconclusive. Model runs by MDEQ in 1999 using Geraghty & Miller's model indicated that ground-water contamination in the sand and gravel aquifer may not be contained at the property boundary. In response to this, the VWF Group conducted pump tests in May 2002, and is in the process of designing one or more shallow extraction wells to assure that contamination in the sand and gravel aquifer is contained and cleaned-up. The design is scheduled to be submitted to EPA and MDEQ in 2002. The VWF Group has committed to implementing the design upon approval of the final design by EPA.

Paint Shop Monitoring: PCE detections at DEQ8, W1I, GMDP4, and GM8 appear to indicate that VOC-contaminated ground-water from the Paint Shop is bypassing the GMBW1 and GMBW2. Model runs by MDEQ in 1999, using Geraghty & Miller's ground-water model indicate that such a bypass could occur in the shallow ground-water. The ground-water that appears to be bypassing GMBW1 and GMBW2 should be recovered by the northern blocking well line. The VWF Group is in the process of designing a new blocking well to the northeast of GMBW1 to address this apparent bypass. The VWF Group has to committed implementing the design upon approval of the final design by EPA.

7. Ground-water Clean-up:

VOC Removal: The dual blocking well/Annex extraction system and the TSRR extraction system are successfully removing VOCs from the aquifers. Since the start-up of the dual blocking well / Annex / Paint Shop pump-and-treat system in December 1996, 1100 pounds of VOCs have been removed by the system (no estimate is available for 1984 -1996, when the treatment system was operated by MDEQ with EPA funding, because treatment system influent concentrations are not available). Since initiation of operation of the TSRR ground-water extraction system, it is roughly estimated that more than 19,000 pounds[18] of VOCs have been removed from the ground-water. At TSRR, a product scavenger pump also was operated from March 1987 - October 1988 to remove LNAPL in the vicinity of monitoring well B18.

Concentrations Trends at Northern Blocking Wells:

In 1997, the total VOC concentrations ranged from 3-42 ug/l – much less than the 100's of ug/l concentrations in the northern blocking wells in 1984. Review of Figures 34 – 39 of the *2001 Annual Monitoring Report* (attached) appears to indicate that VOC concentrations are continuing to decrease in the northern blocking wells (V22, V24, V25, V26, V27 and V28).

VOC detections exceeding CUOs in the latest sampling events (1999, 2000, and 2001) in the northern blocking wells, and monitoring wells upgradient from the northern blocking wells are summarized in Five-Year Review Table 1. The most prevalent VOC exceeding the CUOs is PCE, which is accompanied by a few detections of 1,1-dichloroethylene (1,1-DCE), TCE, and VC. The PCE, TCE and 1,1-DCE detections appear to be concentrated in the northeastern blocking wells and area between the blocking well lines (V-26, V-27, V-28, W-1I, DEQ-7A, DEQ-8A, GMP-6I, GMDP-4, and GM-8). A potential cause of these detections is migration of VOCs from the Paint Shop around the southern blocking well line, as predicted in MDEQ's runs on Geraghty & Miller's model. This emphasizes the importance of adding an additional southern blocking well to capture the shallow ground-water flowing north-northwest from the Paint Shop. Because the distance between the blocking well lines is reduced to the east, it is likely that the PCE and other VOCs between the blocking well lines will be cleaned up quickly once the additional southern blocking well is in place.

The FS estimated that the area between the blocking well lines could be cleaned up in about 12 years. The water quality in the vicinity of the northern blocking wells is already close to the ground-water CUOs. However, it is full cleanup can not occur until the breakthrough in the souther blocking well line is eliminated.

Concentration Trends at TSRR: Overall, the data indicate that the TSRR pump-and-treatment system is resulting in cleaning up of ground-water both within the source area, and downgradient from the source area. The remaining source area

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[18] The 19,000 pound estimate is derived from the 15,123 pounds in Table 6 of the 2000 annual Performance Monitoring Report for Thomas Solvent Raymond Road Source Area plus the following estimate for the period from January 1991 - April 1996: 596 ug/l X 300 gal/min X 3.785 l/gal X 1440 min/day X 1945 day / (4.54 X 10^8 ug/lb). 596 ug/l was the total VOC influent concentration in 1994 from Cost and Performance Report, CH2M-Hill, December 1, 1997.

contamination is much lower in concentration, and is generally restricted to areas near 3 of the extraction wells. The total VOC concentration in the header for the extraction wells has decreased from as high as 19,000 ug/l in 1987 to 200-400 ug/l in 2000.

The attached Figures from the *2000 Annual Performance Monitoring Report for Thomas Solvent Raymond Road Source Area* (MDEQ, May 2001) show the trends in VOCs in extraction wells (EW2-EW9) and monitoring wells (B18S, W16S, W6S, W6I, CH139S, CH139I, W10I) at TSRR. The Figures generally indicate about two orders of magnitude reductions in VOC concentrations in all extraction wells since the TSRR pump-and-treatment system started operating in 1987. More than 3 orders of magnitude reduction has been obtained at monitoring well B-18S. Five of the eight extraction wells (EW2, EW4, EW5, EW7 and EW9) exhibited low-level to non-detect VOC concentrations in recent data. In response to non-detection of VOCs, MDEQ has not consistently pumped EW7 or EW9 since 1999. Hundreds of ug/l of total VOCs are still present in EW3, EW6, and EW8, with concentrations still trending downward when plotted logarithmically. This is also true of the most highly contaminated monitoring well B18S. Individual VOC concentrations in these extraction and monitoring wells still significantly exceed updated CUOs defined in (DRAFT) 2002 ESD TABLE 1, as shown in Five-Year Review Table 2.

In 2000, MDEQ estimated that it will take 7-12 more years to achieve the ground-water CUOs at TSRR. This is the estimated time needed to clean-up TCE and PCE, whose CUOs will not significantly change in the 2002 ESD. This estimate is within the range of the estimated time for complete ground-water clean-up in the FS.[19]

Some TSRR monitoring wells that were highly contaminated are now cleaned up, including W16S and W10I. Downgradient monitoring well W6D was cleaned up within a few years of the start of operation of the TSRR system. VOC concentrations in downgradient monitoring well CH139S have been reduced by more than two orders of magnitude since the start of operation. VOC concentrations in downgradient monitoring wells CH139I, W6I and W6S have remained relatively constant since the start of operation. Apparently these three monitoring wells are continuing to be recharged from contaminant lost from the TSRR source area, or from highly contaminated ground-water that was historically outside the TSRR source area (such as areas around CH139S, and possibly from near W16S). Contamination in these monitoring wells will continue to migrate downgradient for capture by the southern blocking well line.

In 1997, CH_2M-Hill estimated that the operation of the TSRR ground-water pump-and-treatment system would cost about $85,000 per year. The biggest expense category was for one vapor phase carbon change out per year, costing about $38,000.

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[19] The FS estimate was 20-30 years, compared to 14 years operated + (7 - 12 years to complete) = 21 - 26 years).

Annex Concentration Trends: Trends in source area VOCs are mixed, and B8S, B9 and B25 still contain hundreds of ug/l of Bis, PCE and TCE, albeit these concentrations are orders of magnitude below the concentrations detected during the RI. Figures 1, 3 and 4 of the *2001 Annual Monitoring Report* plot trends in VOC results for the most contaminated source area monitoring wells at the Annex. At B8S, Bis and PCE have decreased dramatically since the RI. At B9, PCE and TCE appear to have decreased significantly, but VOC degradation products, Bis and VC increased substantially until 2001 when their concentrations dropped. At B25, TCE appears to have decreased, but there is no clear trend for PCE or 1,1,1-trichloroethane. The FS estimated that all ground-water could be cleaned up in 20 to 30 years. At this time, it is too early in the cleanup to evaluate this estimated time for cleanup.

The closest downgradient monitoring well with a good history of analytical data is CH150I. VOCs substantially decreased in concentration in CH150I before the Annex extraction system started operating, but subsequently Bis, vinyl chloride and TCE have increased. The VWF Group installed four additional monitoring wells in 2000 to provide additional downgradient and side-gradient monitoring locations closer to the Annex.

Paint Shop Concentration Trends: Most of the remaining VOC contamination at the Paint Shop appears to be located toward the top of the upper sandstone aquifer in the vicinity of monitoring wells CH145 and W14. Hundreds of ug/l of PCE remain in these wells, albeit the current concentrations are orders of magnitude less than those detected during the RI. Figures 27 and 28 from the *2000 Annual Monitoring Report*, and Figures 43 and 44 from the *2001 Annual Monitoring Report* plot trends in VOC results for the historically most contaminated source area monitoring wells at the Paint Shop (CH141, CH145, W14 and W13). The VOC concentration decrease is due to natural biodegradation and flushing into the northern or southern blocking well line. Although VOC concentrations have been decreasing in the Paint Shop source area, the highest PCE detection upgradient from the southern blocking wells is at the Paint Shop. This suggests that source area extraction at the Paint Shop may be worthwhile in reducing the period of time of operation of the southern blocking wells. The FS estimated that all ground-water could be cleaned up in 20 to 30 years. At this time, it is too early in the cleanup to evaluate this estimated time for cleanup.

Southern Blocking Well Line Concentration Trends: After an initial decrease from 1997, VOC concentrations in the southern blocking wells have remained fairly constant (see attached Figures 12 – 19 from the *2001 Annual Monitoring Report*). In July 2001, concentrations ranged from 10 ug/l or less total detected VOCs in GMBW1, GMBW2, GMBW3, GMBW4, and GMBW8 to more than 50 ug/l in GMBW6 and GMBW7 in 2001. In July 2001, three of the eight southern blocking wells had VOC concentrations less than the CUOs identified in (DRAFT) ESD TABLE 1. Because of the still substantial VOC contamination in the Annex and TSRR downgradient plumes, and at the Paint Shop, the areas upgradient from the southern blocking wells are still in the early stages of clean-up.

8. Soil Clean-up and Monitoring:

TSRR: The TSRR SVE system was very successful in removing VOCs from the vadose zone soils. It is estimated that the SVE system removed 50,000 pounds of VOCs during the period of operation from 1988-1992, and left only an estimated 0.5 pound of VOCs in the vadose zone soils. This was 29 times the original estimate of 1,700 pounds of VOCs in the soil. The SVE system at TSRR consisted of 24 vapor extraction wells, an air/water separator, two blowers, and an off gas treatment system. Twenty-one underground storage tanks were removed from TSRR in 1991.

The TSRR soil clean-up verification sampling conducted in June 1992, demonstrated that the SVE system effectively reduced soil VOC concentrations to below or close to the CUOs, and, therefore, indicated that enhancements to the SVE were not necessary. The sampling included collection of 104 separate samples from 26 soil borings, for analysis of VOCs. The only VOC detected was PCE, which was detected in 17 samples in concentrations ranging from 15-711 ug/kg. Of the exceedances, 15 were less than 70 ug/kg, one was 140 ug/kg, and one was 711 ug/kg. It should be noted that 99% of the VOC contamination was removed between March 1988 and September 1990, while only 1% was removed between February 1991 and May 1992. However, the long period of operation may have been necessary to reach the low-level CUOs. MDEQ is currently reviewing whether the soil verification sampling indicates achievement of MDEQ criteria and the soil CUOs for VOCs. Additional sampling at TSRR for SVOCs, pesticide/PCBs and metals may be necessary based on the results of the soil screening sampling.

Annex and Paint Shop: SVE was performed at the Annex and Paint Shop from April 1993 through June1994. The SVE system at the Annex included 18 SVE wells and 7 piezometers. The SVE system at the Paint Shop included 4 SVE wells and 3 piezometers. Off gas from each systems was treated via carbon adsorption. Geraghty & Miller estimated that the SVE system at the Annex removed 4,645 pounds of VOCs, and at the Paint shop removed 2,340 pounds of VOCs.

Geraghty & Miller's interpretation of vacuum readings indicated that the SVE system may not have influenced the entire extent of soil contamination at the Annex and Paint Shop as defined in the *SVE Systems Final Design Report,* Geraghty & Miller, July 13, 1993. The areas of influence were further reduced after October 1993 when vacuum and air flow rates for both SVE systems were reduced to lessen accumulation of water in the air/water separator, which had been causing severe operational difficulties. EPA approved temporary shut-down of the SVE systems until the water table at each site was lowered, as was anticipated to occur as a result of operation of the pump-and-treat systems.

The results from preliminary soil sampling conducted in 1996, indicates that the SVE systems were most likely very successful in reducing VOC concentrations at the Annex and Paint Shop. Total VOCs at the most contaminated location of the Annex were reduced from 649,000 ug/kg to 264 ug/kg in 1996. However in 1996, PCE at that sampling location was 240 ug/kg, which substantially exceeds the soil CUO of 20 ug/kg.

The additional soil boring sampling conducted north of the previously defined source area at the Paint Shop during 2000, provides assurance that the extent of the Paint Shop source area was accurately delineated during the RI.

The final soil sampling to assess achievement of the soil CUOs has not yet been conducted, but EPA and MDEQ have approved the *Final Soil Cleanup Verification Sampling Plan*, which defines the sampling required to fully evaluate the effectiveness of the SVE treatment at the Annex and Paint Shop, and determine whether further actions are needed. SVOC, pesticide/PCB or metals parameters may have to be added to this sampling effort based on results of the soil screening sampling.

9 Surface Water Discharge:

Discharge from the Dual Blocking Well / Annex / Paint Shop Pump-and-treat System: The ground-water treatment system for the blocking well lines and the Annex consists of an air stripper and discharge to the Battle Creek River. System monitoring, discharge sampling for VOCs and reporting is conducted monthly, in accordance with the SRD. The treatment system has been successful in consistently reducing VOCs to below the discharge limits. There have been no exceedances of water discharge limitations since the VWF Group took over operation of the system in June 1996 (the VWF Group operated the original system for a few months before constructing the dual blocking well / Annex / Paint Shop pump-and-treat system in December 1996). In fact, there have been no detections in the discharge except for low-level detections of Chloroform in April and May 2000, and of 1,2-DCE in July and August 2001. The chloroform detections have been attributed to an extraction well cleaning chemical. The 1,2-DCE detections may have been indicative of the need for change-out of the air stripper packing, which was addressed by a packing change-out completed in May 2002.

During 2000 and 2001, even the treatment system influent was less than the discharge limitations during every month except April 2000 and July 2001. As previously mentioned in Section V.7, as part of its renewal of discharge limitations, MDEQ Surface Water Quality Division determined that the discharge from the northern blocking well line meets discharge limitations without treatment.

Discharge from TSRR: The TSRR ground-water treatment system consists of an air stripper and discharge to the Battle Creek River via discharge to a nearby storm sewer. System monitoring, discharge sampling for VOCs, and reporting are conducted monthly, in accordance with the requirements of the SRD. The TSRR air stripper was designed to achieve 96% removal of Bis. Effluent samples have consistently met discharge limits except in January and February 2000 when Bis slightly exceeded the discharge limit of 15 ug/l. This exceedance was apparently caused by reduced capacity of the air stripper because of iron fouling. To address this problem, the packing material was replaced in March 2000.

Annex Pipeline: Untreated VOC-contaminated ground-water from the Annex is pumped through a pipeline to the VWF treatment facility. This pipeline was originally installed by EPA in 1987, to convey untreated contaminated ground-water from the TSRR source area to the VWF treatment facility. About half of the pipeline went through an existing storm sewer, and half through subsurface soil. The portion that went through the storm sewer was not double contained, but the portion going through soil was double contained. In 1996, EPA discontinued use of the pipeline after completion of construction of a separate ground-water treatment system for TSRR. In the same year, the VWF Group constructed the Annex and blocking well remedy including connecting to the existing pipeline to transport Annex ground-water. The portion of the Annex pipeline going through the storm sewer was reconstructed inside a new 36 inch diameter storm sewer by City contractors in 1997, during relocation of utilities associated with construction of the Emmett Street Overpass. The portion of the pipeline going through the 36-inch storm sewer is still not double contained, and there is no system in place to detect leaks.

The possibility of leakage into the storm sewer appears to be low for the following reasons:

- the portion of the force main within the storm sewer is 4-inch diameter, SDR11, HDPE, which is highly resistant to puncture, fracture, corrosion, and collapse;
- it was pressure tested by the City's contractor when reconstructed in 1997;
- there has never been a noticeable leak associated with this HDPE piping, the original portion of which has been in service since 1987.

In spite of this any leakage of VOC-contaminated ground-water from the force main into the storm sewer would be undetected, and the existing pipeline does not meet the stringent requirements for secondary containment and a leak detection system in 40CFR264.193.

10. Air Emissions: The VWF Group (for the dual blocking well / Annex / Paint Shop pump-and-treat system), and EPA and MDEQ (for TSRR) have complied with the requirements of the SRDs for air emissions.

Dual Blocking Well / Annex / Paint Shop Pump-and-treat System Air Stripper Emissions: The air emissions were controlled by an activated carbon adsorption until September 2001. In the August 2, 2001, SRD, MDEQ Air Quality Division expressed confidence that the emissions from the air stripper under current (spring 2001) conditions would comply with the SRD discharge limitations without treatment, and approved deactivation of the unit. The carbon adsorption unit remains in place and can be reactivated if necessary.

Annex and Paint Shop SVE Emissions: The Annex and Paint Shop SVE systems also used carbon adsorption to control emissions. Air emission samples were routinely collected from the primary and secondary carbon units and the air/water separator and analyzed with an on-site gas chromatograph. When breakthrough was detected from the primary carbon unit, a carbon change out was performed. There were no definitive detections of breakthrough from the secondary carbon unit, and no exceedance of the MDNR emission criteria (0.4 lb/hr for the Paint Shop and 1.5 lb/hr for the Annex).

TSRR Air Stripper Emissions: Air emissions from the TSRR air stripper have also been controlled using a dual in-series carbon adsorption system. The carbon for control of the TSRR air stripper emissions is changed out about once a year, based on the determination of a conservative loading capacity for the carbon charge based on extensive sampling during the initial charge of carbon. This process for activated carbon replacement is designed so that there will be zero emissions.

TSRR SVE Emissions: TSRR's SVE system used carbon adsorption to control emissions from start-up in 1988, until December 1989, and from 1991-1992. From 1990-1991, a catalytic oxidizer was used for control. When carbon adsorption was used, air emissions between two in-series carbon canisters and from the secondary carbon canister were sampled monthly. When the discharge limits were exceeded as measured between the primary and secondary carbon canisters, the primary carbon canister was removed and replaced with the canister in the secondary position, and a fresh carbon canister replaced in the secondary position. Stack gas sampling during use of the catalytic oxidizer verified that the system was in compliance with Michigan Department of Natural Resources (MDNR) discharge limitations (MDNR was the predecessor of MDEQ).

11. Off-Site Disposal:

Available documentation indicates that all waste materials were properly disposed of.

RI Sampling Residuals: Drilling fluids from Phase I and Phase II were either contained for testing and off-site disposal, or discharged to a City sanitary sewer. Well development water and purging water collected prior to sampling was discharged to a City sanitary sewer. Later, well development water, sample purge water, and decontamination water were disposed of in the wet-well at the VWF air stripper.

In 1987, EPA disposed of contaminated soil from the RI by stabilization to remove water, followed by disposal in a RCRA hazardous waste landfill.

Spent Carbon: All spent carbon for control of the TSRR, Annex, and Paint Shop SVE systems, and the TSRR and VWF air strippers has been transported off-site as RCRA hazardous waste and regenerated.

Air-Water Separator for Annex and Paint Shop SVE: Water from the air-water separator for the Annex and Paint Shop SVE systems was disposed of in the wet-well at the air stripper.

Demolition Wastes: In 1995, the SVE system and free product tank from the TSRR ground-water treatment system were dismantled, decontaminated and disposed of off-site in a nonhazardous Subtitle D landfill. Concrete from a decontamination pad at TSRR was disposed of off-site in a RCRA hazardous waste landfill.

Other Residuals Generated by the VWF Group: The *Remedial Action Construction Completion Report,* Geraghty & Miller, June 1997, includes documentation demonstrating compliance with Agency requirements for handling and disposal of soil cuttings from well installation.

In June 1996, and May 1999, the VWF Group replaced the packing in the air stripper because of iron fouling. Testing results indicated that it was nonhazardous. The packing material was shredded, sampled, analyzed, and then disposed of off-site as a nonhazardous solid waste.

12. Deed and Access Restrictions, and Institutional Controls:

Dual Blocking Well / Annex / Paint Shop Pump-and-treat System: Access to these areas/ facilities is restricted by their location within the City of Battle Creek owned property for the Verona Well Field and iron/manganese removal facility, to which access is restricted by security fencing and locked gates.

Annex and Paint Shop: The Annex and Paint Shop properties are owned by Grand Trunk. These properties are part of Grand Trunk's transportation and maintenance facility and are zoned industrial. In addition, much of the contaminated ground-water downgradient from all three source areas underlie Grand Trunk properties. The Annex and Paint Shop are very unattractive for residential development because they are adjacent to or part of a railroad yard. The VWF Group is working on use restrictions on these properties to prevent exposure to contaminants and interference with remedial actions. The Annex source area is landlocked, and access is only available through the Grand Trunk facility. In addition, the Annex source area has been properly fenced to further restrict access to the area of contaminated soil, ground-water extraction system, monitoring wells and SVE equipment. The locked access gate to the Annex is adjacent to an active railroad track, and specific access and safety protocol are in place to limit site access to only trained and approved personnel. The Paint Shop is not fenced but is within an operating area of the Grand Trunk maintenance facility, which includes access restrictions.

TSRR: The TSRR source area has been properly fenced to restrict access to the area of the pump-and-treat equipment. Currently there are no deed restrictions on the usage of the TSRR property. The TSRR property is zoned industrial and has been used for industrial purposes for many years, but is also adjacent to a residential area.

Residential Areas: It is possible that contaminated ground-water remains under the residential area located west-northwest of the Annex and TSRR source areas and south of the City owned VWF. Ground-water in this area was highly contaminated in 1984, but subsequent data has demonstrated substantial decreases. Residences in this area are now connected to the City of Battle Creek water supply system. However, there is no actual law prohibiting these residences from use of ground-water below their homes. The VWF Group and MDEQ have been working with the Townships to introduce an ordinance prohibiting use of ground-water in this area.

V. Progress Since the Last Review

This is the first 5-Year Review for the site.

VI. Five-Year Review Process

Administrative Components and Community Involvement

Representatives of the VWF Group, the City of Battle Creek, and MDEQ were notified of the start the five-year review process during a conference call in August 2001. Other interested parties were given an opportunity to provide input in the review through a notice in the Battle Creek Enquirer on June 2, 2002. The RPM started researching for this Five-Year Review on October 5, 2001. The initial draft of the Five-Year Review was distributed to MDEQ, the City of Battle Creek and the VWF Group on November 6, 2001, and the related initial draft of the 2002 ESD was distributed on November 7, 2001. The second draft Five-Year Review and ESD were distributed to the same parties on July 30, 2002. The VWF Group provided comments on the initial draft ESD and the initial draft Five-Year Review in letters dated April 16, 2002, and April 23, 2002, respectively; and provided comments on the second drafts in two letters dated September 13, 2002. The City of Battle Creek provided comments on the initial draft ESD and Five-Year Review in letters dated May 9, 2002, and June 14, 2002, respectively. MDEQ provided comments on the initial draft ESD and Five-Year Review in letters dated May 23, 2002, and July 30, 2002, respectively. The Five-Year Review is scheduled to be completed by September 30, 2002.

Document Review

This Five-Year Review included a review of background information to characterize: historical conditions; remedial action requirements; the extent of sampling conducted; historical performance of the remedy; and anticipated future actions and agreements. Particular attention was paid to the remedial investigation (RI) reports, Record of Decision (ROD), documents, unilateral administrative orders (UAO) and the draft 2002

Explanation of Significant Differences (ESD), modeling runs by the VWF Group and MDEQ, reports on performance of the systems, and the Verona Well Field *Interim Commitment*, which was developed by the VWF Group, MDEQ, the City of Battle Creek, and EPA. The draft 2002 ESD was developed concurrently with this Five-Year Review, and is incorporating some of the recommendations developed during the Five-Year Review. MDEQ, the VWF Group and the City have already had extensive input into the draft ESD. Documents used for preparation of this report are included in the Administrative Record for the 1991 ROD or will be included in the 2002 ESD. As part of the Five-Year Review, EPA conducted a site inspections on March 8, 2001, and August 27, 2002. A screening-level risk assessment was also performed.

This Five-Year Review report was prepared by EPA staff with input from staff of MDEQ, the VWF Group, and the City of Battle Creek. The report was drafted by Richard Boice, who has been EPA's remedial project manager (RPM) for this site since 1996. EPA is relying on technical support from MDEQ staff, including Beth Mead-O'Brien, who has been MDEQ's site manager for this site since 1989; and Matthew Baltusis, Hydrogeologist. Andrew Podowski, an EPA risk assessment specialist, provided support in preparation of the risk assessment review. In addition, the VWF Group and the City of Battle Creek provided input and comments on the Five-Year Review before it was finalized.

VII. Technical Assessment

QUESTION A: IS THE REMEDY FUNCTIONING AS INTENDED BY THE DECISION DOCUMENTS?

Protection of the City of Battle Creek Water Supply: The original blocking well system and the dual blocking well system have been effective in protecting the City water supply from VOC contamination. It appears likely that some breakthrough of VOC contaminated ground-water has occurred during periods of remedial system and extraction well down-times, and periods of relatively high City water production. This breakthrough is indicated by low-level VOC detections in the sentinel wells located north of the northern blocking well line and in a few seldom used City production wells and is suggested by modeling results. However, this breakthrough has not resulted in a detectable impact on the overall City water supply, as indicated by samples from the influent to the iron/manganese removal plant. It is possible that more substantial breakthrough of VOC contaminated ground-water will occur if the City water demand further increases. It is unclear what impact this would have in the City water supply, but should not be considered an emergency situation because the VOC levels in the vicinity of the northern blocking wells only marginally exceed MCLs.

Implementation of the Verona Well Field Management Plan and enhancements to the ROD remedy being implemented under agreements among the VWF Group, the City and the State of Michigan should provide even more protection to the City water supply under current conditions, and provide assurance that breakthrough of VOC contaminated ground-water will not occur in the future even if the City water demand increases to as high as 30 mgd, which is well beyond production conditions used for design of the ROD remedy. In addition, the more sophisticated monitoring will be implemented under these agreements may improve the ability to detect breakthrough as long-term operation continues and changes in City production occur.

<u>Meeting Design Requirements</u>: The dual blocking well / Annex / Paint Shop pump-and-treatment system was constructed, and is being operated, monitored and maintained in accordance with the EPA-approved design, with the following exception:

The final design provided that start-up data would be collected to determine whether the upper sandstone monitoring wells at the Annex are being influenced by the ground-water extraction wells. This evaluation was not provided by the VWF Group nor required by EPA at the time. As a result, evaluation of containment of the sand-and-gravel aquifer at the Annex has been a prolonged process. Testing is now being conducted by the VWF Group for design of extraction wells in the sand-and-gravel aquifer at the Annex.

The TSRR pump-and-treatment system was constructed, and is being monitored in accordance with the EPA-approved design. However, because of restrictions in the discharge line, between 1997 and 2001. the ground-water extraction rate gradually decreased from the 300 gpm design rate to as low as 130 gpm. In 2001, MDEQ temporarily addressed this problem by using a temporary surface discharge line, and increasing the extraction rates to 150-200 gpm. MDEQ installed a permanent replacement discharge line in May 2002, and is now operating the system at about 220 gpm.

The Annex, Paint Shop and TSRR SVE systems were constructed and operated in accordance with the EPA-approved designs.

<u>Source Area Ground-water Containment and Ground-water Clean-up</u>: The dual blocking well / Annex / Paint Shop Pump-and-treat system, and the TSRR pump-and-treat well system have been effective in removing VOCs from the ground-water. VOC concentrations at the northern blocking wells are greatly reduced from concentrations in 1984. It appears that the area between the blocking well lines could be cleaned up within a few years if an additional extraction well is installed to cut-off shallow ground-water migration around the northeastern end of the southern blocking well line, a measure that is being designed and will be implemented along with enhancements to the ROD remedy implemented in accordance with agreements among the VWF Group, the City, and MDEQ.

Available data indicate that it will take many years to clean up the aquifers between the source areas and the southern blocking wells. This is consistent with the expectation from the FS. Clean-up of this portion of the aquifer, will be enhanced when reliable ground-water containment is achieved at the Annex and Paint Shop.

The TSRR extraction system generally appears to have been effective in containing contaminated source area ground-water, and in reducing the VOC concentrations and extent of contamination at that source area. However, this is under further investigation by MDEQ. The pace of ground-water clean-up at TSRR is consistent with expectations from the FS. Migration of VOCs from the downgradient plume area has been more than desired in the 1991 ROD, but it is unjustifiable to construct a downgradient extraction system at this time.

The ground-water clean-up systems for the Annex and Paint Shop ground-water were not constructed until 1996 (compared to 1987 for TSRR). This has resulted in more loss of VOCs to areas downgradient from the source areas than desired in the 1991 ROD. It still has not been demonstrated that source area ground-water is being contained at the Annex and Paint Shop. The VWF Group has conducted aquifer testes at the Annex and Paint Shop source areas. The results of the Annex aquifer testing will be used to evaluate the adequacy of the existing Annex ground-water extraction system, and the location of additional recovery wells to ensure containment of the ground-water in the sand and gravel, and upper sandstone aquifers at the northern property boundary of the Annex. The results of the Paint Shop testing will be used to design a pump-and-treat system to improve mass removal in the vicinity of the Paint Shop source area, and to ensure that the additional blocking well to extend the southern blocking well line to the northeast will capture contaminants migrating from the Paint shop.

<u>Source Area Soil Clean-up</u>: The SVE system at TSRR was very effective in removing VOCs from the vadose zone soils, and may have achieved the ESD CUOs.

Preliminary soil sampling results from the Annex indicates that the SVE system was probably effective in reducing soil VOC concentrations at the Annex and Paint Shop, but it may not have been effective enough to achieving the soil CUOs. The EPA and MDEQ-approved *Final Soil Verification Sampling Plan* is expected to be implemented within the next few years, and will provide sufficient data to evaluate the effectiveness of the SVE treatment, and whether any additional soil remedial measures are necessary.

<u>Compliance with Air and Surface Water Discharge Limitations, and Off-site Disposal Requirements</u>: The parties implementing the remedial actions have complied with these requirements. Currently, air and water discharge concentrations for the dual blocking well / Annex / Paint Shop pump-and-treat system have been reduced enough

to relax treatment requirements.

QUESTION B: ARE THE EXPOSURE ASSUMPTIONS, TOXICITY DATA, CLEANUP LEVELS, AND REMEDIAL ACTION OBJECTIVES USED AT THE TIME OF THE REMEDY STILL VALID?

Comparison of Draft ESD CUOs with Region 9 Preliminary Remediation Goals (PRGs) and Soil Screening Levels (SSLs):

The CUOs are concentrations that should be achieved in soil and ground-water at the end of the remedial action, when the properties and ground-water will no longer be controlled and should be available for usage without any restrictions imposed because of the currently existing contamination (neither containment nor access restrictions are part of the selected remedy). To assure that the CUOs are protective to human health, the Five-Year Review compares them with the Region 9 PRGs and Region 9 SSL, as appropriate.

The draft ESD CUOs are nearly finalized; so the draft ESD CUOs will be used instead of the CUOs in the 1991 ROD. However, there may be further discussion of the CUOs especially regarding the proper inhalation reference dose for chloroform, which could result in very different CUOs. For example, Progressive used an inhalation reference dose equal to 0.01 mg/kg-day and calculated Non-Cancer Risk Goal and CUO for ground-water of 77 ug/l, while EPA used an oral reference dose of 0.001 mg/kg-day and calculated a Non-Cancer Risk Goal of 0.73 and a CUO of 1.0. In any case, the final CUO will be set at a protective level.

Region 9 has calculated PRGs for residential soil, industrial soil, ambient air, and tap water. Region 9 has also calculated SSLs for 100 of the most common contaminants at Superfund sites, using both a dilution-attenuation factor of 20 and 1. The PRGs are meant to be a conservative screen for risks presented by contaminant concentrations in these media. The PRGs are set at concentrations calculated to provide human health protection to a level such that the exposure rate is equal to the reference dose for non-carcinogens, and for carcinogens to a 1 X 10^{-6} lifetime incremental carcinogenic risk level. Conservative exposure assumptions and the most up to date toxicity factors (generally from EPA's Integrated Risk Information System (IRIS)) are used. The Region 9 SSLs were developed to identify contaminant concentrations in soil that have the potential to contaminate ground-water at the tap water PRG concentration. The SSLs utilize a standard fold dilution-attenuation factor of either 20 or 1, and a soil-water partitioning equation. Because the PRGs and SSLs are calculated conservatively, it is safe to conclude that a CUO is protective if the CUO is approximately equal to or less than the PRGs. Otherwise the CUO needs to be further discussed or evaluated.

PRGs used to compare to the ground-water CUOs are the tap water PRGs. The SSLs used to compare to soil CUOs are the "Migration to Ground-water, DAF 20" PRGs, which are for protection of ground-water from migration from contaminated soil assuming a 20 fold dilution-attenuation factor, except for chloroform for which the residential soil exposure PRG was more stringent.

The draft ESD CUOs for ground-water and soil are compared to the Region 9 PRGs and SSLs in Table 3. For derivation of the CUOs for SVOCs and metals, the tap water PRGs were actually used as the Cancer and Non-Cancer Risk Goals. In derivation of the CUOs for VOCs, the same toxicity factors were used for calculation of the Cancer and Non-Cancer Risk Goals for derivation of the CUOs as used for the PRG comparison. The toxicity factors from the November 22, 2000, update of the Region 9 PRGs and SSLs were used for all parameters except for chloroform and 1,1-DCE, which have updated toxicity factors in IRIS. In addition, for VOCs the exposure assumptions for calculation of the Cancer Risk Goals and Non-Cancer Risk Goals in ground-water were similar to procedures for calculating the PRGs.

Inspection of Table 3 for comparison of the ground-water CUOs with the PRGs, shows that for most VOCs the CUOs only marginally exceed the PRGs. This group includes acetone, chlorobenzene, chloroform, 1,1-DCA, Bis, 1,2-DCE (trans-), methylene chloride, PCE, toluene, TCE, and VC. One group of exceptions includes the VOCs: ethylbenzene; 1,1-DCE; 1,1,1-trichloroethane; and xylene. For these VOCs, the ground-water CUOs are based on the Michigan criteria, which are more stringent than the PRGs. This is also true of most metals including aluminum, antimony, beryllium, cadmium and nickel. Based on this comparison, we can conclude that the ground-water CUOs for contaminants listed in this paragraph are protective.

Another group of exceptions are those contaminants whose CUO substantially exceeds the PRG because the CUO is being set at the target detection limit (TDL). These contaminants are potent carcinogens, and as a result their Cancer Risk Goals and PRGs are significantly less than what it is practical to detect using generally available analytical methods. This group includes benzene, carbon tetrachloride, 1,1-DCA, 1,1-DCE, 1,1,2-trichlorethane, vinyl chloride, arsenic, and n-nitroso-di-n-propylamine. The CUOs for the VOCs in this category are still protective because they exceed the PRGs by less than 2 orders of magnitude, which indicates that the risk level at the CUOs for each VOC is less than 1 X 10^{-4}. On the other hand, the CUOs for arsenic and n-nitroso-di-n-propylamine exceed the 1 X 10^{-4} risk levels. However, arsenic is also present in background ground-water and, therefore, 10 ug/l detections may not represent an incremental risk from the Site. This will be further investigated by review of the results of background sampling that has recently been conducted. In addition, it is difficult to quantitate arsenic below 10 ug/l. N-nitroso-di-n-propylamine is a relatively unstable compound that is not expected to persist. Therefore, the CUOs for these parameters are protective.

The final group of exceptions include lead and sodium, for which a PRG has not been calculated. It should be noted that the CUO for lead is based on the Michigan criteria and is less than lead's MCL. Therefore, these CUOs are protective.

Inspection of Table 3 for comparison of the soil CUOs with the SSLs, shows that CUOs are less than or equal to the PRGs for about half of the VOCs, but that the CUOs exceeds the PRGs for the other half. Considering the conservatism of the SSLs and that the CUOs for the most critical parameters in soil including PCE and TCE are more stringent than the SSLs, the draft ESD soil CUOs are protective.

Baseline and Background Sampling for Certain Metals and SVOCs

EPA, MDEQ, and the VWF Group conducted an extensive review of available ground-water data. Based on this review certain SVOCs and metals were identified as a concern because either there was insufficient data or that the data included detections near or exceeding Michigan, Part 201, generic ground-water cleanup criteria for residential and commercial drinking water, and/or the federal Maximum Contaminant Levels in source area ground-water samples. For example arsenic was detected in Annex monitoring wells at 290 úg/l in monitoring well B-8S in 2001, 52 ug/l in B-09 and 140 ug/l in B-25 in 2000, and at 10.9 ug/l in B-23 in 1996. These detections exceed the MCL for arsenic of 10 ug/l. Therefore, these SVOCs and metals will be incorporated into the long-term monitoring program and CUOs have been established for these contaminants in Table 1 of the ESD. The ESD also provides procedures for evaluating the results of baseline ground-water sampling and background sampling to determine whether certain of these contaminants already achieve the CUOs, and whether monitoring for certain of these contaminants can be discontinued. The monitoring and processes set up in the ESD is necessary to assure that the remedy is protective.

Source Area Soil Screening Sampling for SVOCs, Pesticide/PCBs and Metals

EPA's review of available documentation indicates that the 1991 ROD decision not to require remedial actions to address pesticide/PCBs, and most SVOCs, and metals in soil, was based upon only very limited data. In 1991, it was reasonable to proceed with remedy selection based on the available RI data because it was obvious that VOCs were the primary problem at both the source areas and the VWF. However, it may not be protective to release the sites from EPA-imposed controls (although EPA recognizes that the Paint Shop and Annex will almost certainly continue to be used for industrial purposes) without some additional data on SVOC, pesticide, PCB, and metal concentrations in the soil and ground-water.

To address concern about limited SVOC, pesticide/PCB, and metals data in source area soils, the ESD requires screening-level sampling of soils and screening the results against State of Michigan soil criterial. SVOCs, pesticide/PCB and metal parameters that exceed the criteria will be added to the statistical sampling for evaluating achievement of the soil CUOs, and, if the criteria exceeded was for protection of ground-water, to the source area long-term grour d-water monitoring.

Consideration of Cumulative Risk and Other Migration Routes: For each individual contaminants, the CUO is established at concentrations that could cause an exposure rate equal to the 10^{-6} cancer risk level (unless there are analytical limitations) or equal to the reference dose for non-carcinogens. Therefore, there may be concern that the additive effects of being exposed to multiple contaminants may results in the remedy not being protective. However, experience has shown that as VOCs are cleaned up in the ground-water and soil, eventually only one or two contaminants remain that present a significant risk. The remaining contaminants will almost always be those with a CUO based on cancer risk because the CUOs for significantly carcinogenic contaminants are always much more stringent than CUOs based on reference doses. Furthermore, the CUOs are set at or below the 1×10^{-6} risk level This was demonstrated by the post-SVE soil sampling at TSRR, in which PCE was the only VOC detected. Therefore, it is protective to establish the CUOs without adjustment to address additive risk for exposure to multiple contaminants.

Risk Screening of ROD CUOs: The soil and ground-water CUOs in the draft 2002 ESD will be protective for when the property and ground-water become uncontrolled, and available for unrestricted usage.

Adding Certain SVOCs and Metals to the Long-Term Ground-Water Monitoring and Cleanup Requirements, and Soil Screening for SVOCs, Pesticide/PCBs and Metals: The ground-water and soils have been extensively assessed and monitored for VOC contamination. Unfortunately, certain SVOCs and metals have not been adequately characterized in source area ground-water or in background ground-water, and the RI did not provide adequate data for screening SVOCs, pesticide/PCBs, and metals in source area soils. This problem is being addressed through the draft 2002 ESD by:

- Adding certain SVOCs and metals to the source area ground-water monitoring and cleanup requirements. The monitoring and cleanup requirements for these parameters may be eliminated later based on baseline source area and background ground-water sampling results.
- conducting screening-level sampling for SVOCs, pesticides, PCBs and metals in source area soils. These results will be evaluated using appropriate criteria, and added to the more extensive soil sampling and ground-water monitoring if necessary.

Annex Pipeline: Currently a single walled high density polyethylene pipeline is used to transport contaminated ground-water from the Annex to the air stripper. Part of this pipeline goes through a storm sewer. There is no way of detecting leaks of contaminated ground-water from the portion of the pipeline that goes through the storm sewer other than visually observing the discharge to the wetwell. This condition may not be protective of the environment because such leakage may have significant adverse impacts on aquatic life in the Battle Creek River. Compliance with the requirements in 40 CFR 263.193 is necessary to ensure that the remedy is protective of the environment.

QUESTION C: HAS ANY OTHER INFORMATION COME TO LIGHT THAT COULD CALL INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?

Adding Certain SVOCs and Metals to the Long-Term Ground-Water Monitoring and Cleanup Requirements, and Soil Screening for SVOCs, Pesticide/PCBs and Metals: The ground-water and soils have been extensively assessed and monitored for VOC contamination. Unfortunately, certain SVOCs and metals have not been adequately characterized in source area ground-water or in background ground-water, and the RI did not provide adequate data for screening SVOCs, pesticide/PCBs, and metals in source area soils. This problem is being addressed through the draft 2002 ESD by:

- Adding certain SVOCs and metals to the source area ground-water monitoring and cleanup requirements. The monitoring and cleanup requirements for these parameters may be eliminated later based on baseline source area and background ground-water sampling results.
- conducting screening-level sampling for SVOCs, pesticides, PCBs and metals in source area soils. These results will be evaluated using appropriate criteria, and added to the more extensive soil sampling and ground-water monitoring if necessary.

Annex Pipeline: Currently a single walled high density polyethylene pipeline is used to transport contaminated ground-water from the Annex to the air stripper. Part of this pipeline goes through a storm sewer. There is no way of detecting leaks of contaminated ground-water from the portion of the pipeline that goes through the storm sewer other than visually observing the discharge to the wetwell. This condition may not be protective of the environment because such leakage may have significant adverse impacts on aquatic life in the Battle Creek River. Compliance with the requirements in 40CFR263.193 is necessary to ensure that the remedy is protective of the environment.

VIII. Issues

1. Continue operation, maintenance, and monitoring of the dual blocking / Annex /Paint Shop pump-and-treat system, and the TSRR pump-and-treat system until ground-water CUOs are achieved. Continued operation does affect current and future protectiveness.

2. The agreement between the VWF Group, MDEQ and the City of Battle Creek is strongly supported by EPA. This agreement may affect future protectiveness.

3. Expanded ground-water extraction systems for the Annex and for the Paint Shop should be designed and implemented to assure that source area ground-water is fully captured. This does affect current and future protectiveness.

4. MDEQ should complete its evaluation of the pumping rate necessary to fully contain contaminated source area ground-water at TSRR, and TSRR extraction system adjusted as necessary. This may affect future protectiveness.

5. The 2002 ESD should be approved to incorporate the following requirements:
- adding certain SVOCs and metals into the long-term monitoring and cleanup requirements in the source areas, and to provide a procedure to eliminate these requirements;
- soil sampling to screen for SVOC, pesticide/PCB, and metals contamination in the source areas, and providing procedures to evaluate the data;
- compliance with 40 CFR 264.193 for the Annex pipeline in order to ensure that release of VOCs to the Battle Creek River does not occur.

This may affect future protectiveness.

6. To the extent that ground-water treatment is no longer necessary prior to discharge to the Battle Creek River, and carbon treatment of the air stripper emissions is no longer necessary, these treatment systems should be deactivated. These do not affect current or future protectiveness.

7. MDEQ needs to evaluate whether TSRR soil meets RCRA clean-closure requirements and the revised CUOs proposed in the ESD for VOCs. This may affect future protectiveness.

8. The VWF Group needs to implement the approved *Final Soil Verification Sampling Plan* (as amended as described above) to evaluate whether further soil treatment by SVE is necessary at the Annex and Paint Shop. This may affect future affectiveness.

IX. Recommendations and Follow-up Actions

1. Continue operation, maintenance, and monitoring of the dual blocking / Annex /Paint Shop pump-and-treat system, and the TSRR pump-and-treat system until ground-water CUOs are achieved. For the dual blocking well/ Annex / Paint Shop system, this should continue to be conducted by the VWF Group with oversight by EPA and MDEQ. MDEQ now has full responsibility for operation, maintenance and monitoring at TSRR.

2. The agreement between the VWF Group, MDEQ and the City of Battle Creek is strongly supported by EPA. This agreement should be completed and implemented to provide protection to the City water supply up to City water pumping rate of 30 mgd and

to improve hydraulic and chemical monitoring.

3. An expanded ground-water extraction systems for the Annex and for the Paint Shop should be designed and implemented to assure that source area ground-water is fully captured. The VWF Group is currently in the process of designing these improvements. After review and approval by EPA and MDEQ, they have agreed to construct and operate these expanded systems. The design is scheduled to be completed in 2002.

4. MDEQ should complete its evaluation of the pumping rate necessary to fully contain contaminated source area ground-water at TSRR, and TSRR extraction system adjusted as necessary. This evaluation is now underway.

5. The 2002 ESD should be approved to incorporate the following requirements:
- adding certain SVOCs and metals into the long term monitoring and cleanup requirements in the source areas, and to provide a procedure to eliminate these requirements;
- soil sampling to screen for SVOC, pesticide/PCB, and metals contamination in the source areas, and providing procedures to evaluate the data;
- compliance with 40 CFR 264.193 for the Annex pipeline in order to ensure that release of VOCs to the Battle Creek River does not occur.

This ESD is expected to be approved in 2002. Subsequently, EPA will negotiate with the VWF Group to implement these measures.

6. To the extent that ground-water treatment is no longer necessary prior to discharge to the Battle Creek River, and carbon treatment of the air stripper emissions is no longer necessary, these treatment systems should be deactivated. This would make operation of the systems simpler, subject to fewer maintenance problems, and less costly, although it may be necessary to maintain these systems in place for a number of years as a contingency measure. These actions are the responsibility of the VWF Group and MDEQ, with approval required by EPA and the MDEQ regulatory divisions.

7. MDEQ needs to evaluate whether TSRR soil meets RCRA clean-closure requirements and the revised CUOs proposed in the ESD for VOCs.

8. The VWF Group needs to implement the approved *Final Soil Verification Sampling Plan* (as amended as described above) to evaluate whether further soil treatment by SVE is necessary at the Annex and Paint Shop. This will be overseen by EPA and MDEQ and is scheduled to be completed within the next couple years.

X. Protectiveness Statement

The remedies for the entire Site are protective in the short-term because there is no evidence that there is current significant exposure. In order for the remedy to remain protective in the long term, the following actions are needed, which are not already provided for in enforceable documents or agreements:

- implementation of measures to provide protection to the City water supply in case demand increases;
- incorporation of certain SVOCs and metals into the source area monitoring and cleanup requirements;
- implementation of screening-level sampling of source area soils for SVOC, pesticide/PCB, and metals contamination, and any significant risks from these parameters need to be addressed prior to release of control over these properties;
- implementation of actions to comply with 40 CFR 264.193 for the portion of the Annex force main going through the storm sewer.

EPA is taking the steps outlined in Section VII, Recommended Actions, to make the remedy protective.

XI. Next Five-Year Review

The next five-year review should be conducted by June 2007.

LIST OF ACRONYMS AND ABBREVIATIONS

Annex: Thomas Solvent Company Annex source area, which was leased from Grand Trunk

CH_2M-Hill: CH_2M-Hill, Inc., the EPA contractor who conducted the RI/FS, constructed the SVE and ground-water pump-and-treat system at TSRR, and operated these systems for a few years.

Cis: cis-1,2-dichloroethylene

CUO: clean-up objective from the 1991 ROD or 2002 ESD

1,1-DCA: 1,1-dichloroethane

1,1-DCE: 1,1-dichloroethylene

1,2-DCE: The total of the cis- and trans- isomers of 1,2-dichloroethylene

EPA: United States Environmental Protection Agency

ESD: Explanation of Significant Differences

FS: *Feasibility Study*, an EPA funded report that evaluates alternative remedial actions

Grand Trunk: Grand Trunk Western Railroad Company

GWAMP: *Ground-water and Air Monitoring Plan*, prepared by Geraghty & Miller for the VWF Group

IRIS: EPA's Integrated Risk Information System. This is available from EPA's web site.

LNAPL: light non-aqueous phase liquid on the surface of ground-water

MCL: Safe Drinking Water Act Maximum Contaminant Level

MDNR: The Michigan Department of Natural Resources (predecessor of MDEQ)

MDEQ:	The Michigan Department of Environmental Quality
Paint Shop:	Grand Trunk marshalling yaro Paint Shop source area
PCE:	Perchloroethylene (tetrachloroethylene)
PRG:	Preliminary Remediation Goal, used to develop the 2002 ESD CUOs, and assure that they are protective
Progressive:	Progressive Engineering and Construction, Inc., a technical consultant for the VWF Group
QAPP:	Quality Assurance Project Plan
RI/FS:	Remedial Investigation/Feasibility Study
ROD:	EPA's Decision Document Called a Record of Decision
SRDs:	Substantive Requirements Documents, issued by MDEQ to identify the air or surface water discharge requirements.
SVE:	Soil Treatment by Soil Vapor Extraction
TCE:	Trichloroethylene
TDL:	Target Detection Limit
TSRR:	The Thomas Solvent Company, Raymond Road Source Area
UAOs:	Unilateral Administrative Orders issued by EPA in 1992. One of the UAOs ordered a group of potentially responsible generators to implement the dual blocking well system and Annex source area clean up. The other UAO ordered Grand Trunk to implement the dual blocking well system, and the Annex and Paint Shop source area clean up.
UCL:	Upper confidence limit of a distribution of data
ug/kg:	Concentration of a Contaminant in Soil in Micrograms of Contaminant per Kilogram of Soil (equal to parts per billion by weight).

ug/l:	Concentration of a Contaminant in Water in Micrograms of Contaminant Per Liter of Water (equal to parts per billion by weight)
VC:	Vinyl chloride
VOCs:	Volatile Organic Compounds
VWF Group:	Group of private parties that are implementing remedial actions under UAOs with EPA.

FIVE-YEAR REVIEW TABLE 1

MAXIMUM DETECTIONS IN NORTHERN BLOCKING WELLS AND MONITORING WELLS BETWEEN BLOCKING WELL LINES THAT EXCEED THE 2002 DRAFT ESD CUOs IN RECENT SAMPLING (1999 – 2000)

PARAMETER	WELL	SAMPLING RESULT (UG/L)	DRAFT ESD CUO (UG/L)
PCE	V-26	3.7	1.4
PCE	V-27	7	1.4
PCE	V-28	2	1.4
PCE	W-1I	4	1.4
VC	DEQ-7A	1.3	1
1,1-DCE	DEQ-8A	3.5	1
PCE	DEQ-8A	7.9	1.4
TCE	DEQ-8A	9.1	2.5
1,1-DCE	DEQ-8B	1.6	1
PCE	DEQ-8B	20	1.4
PCE	DEQ-8C	2.2	1.6
PCE	GMP-6I	4	1.4
VC	GMP-6D	3	1
VC	GMP-1D	2	1
PCE	GMDP-4	28	1.4
PCE	GM8	7.8	1.4
TCE	GM8	7.6	2.5
VC	GM2	2	1

FIVE-YEAR REVIEW TABLE 2

CONCENTRATIONS OF VOCS REMAINING AT TSRR

LOCATION/PARAMETER	SAMPLE RESULTS IN 7/2001 and 8/2001 (ug/l)	DRAFT CUO UG/L
EW3/Cis	73	70
EW3/PCE	10	1.4
EW6/Cis	43	70
EW6/PCE	5.8	1.4
EW6/TCE	16	2.5
EW8/Cis	22	70
EW8/PCE	3.5	1.4
EW8/TCE	7.3	2.5
B18S/Cis	16	70
B18S/PCE	36	1.4
B18S/TCE	4.2	2.5

FIVE-YEAR REVIEW TABLE 3
COMPARISON OF ROD CUO'S TO REGION 9 PRGs/SSLs

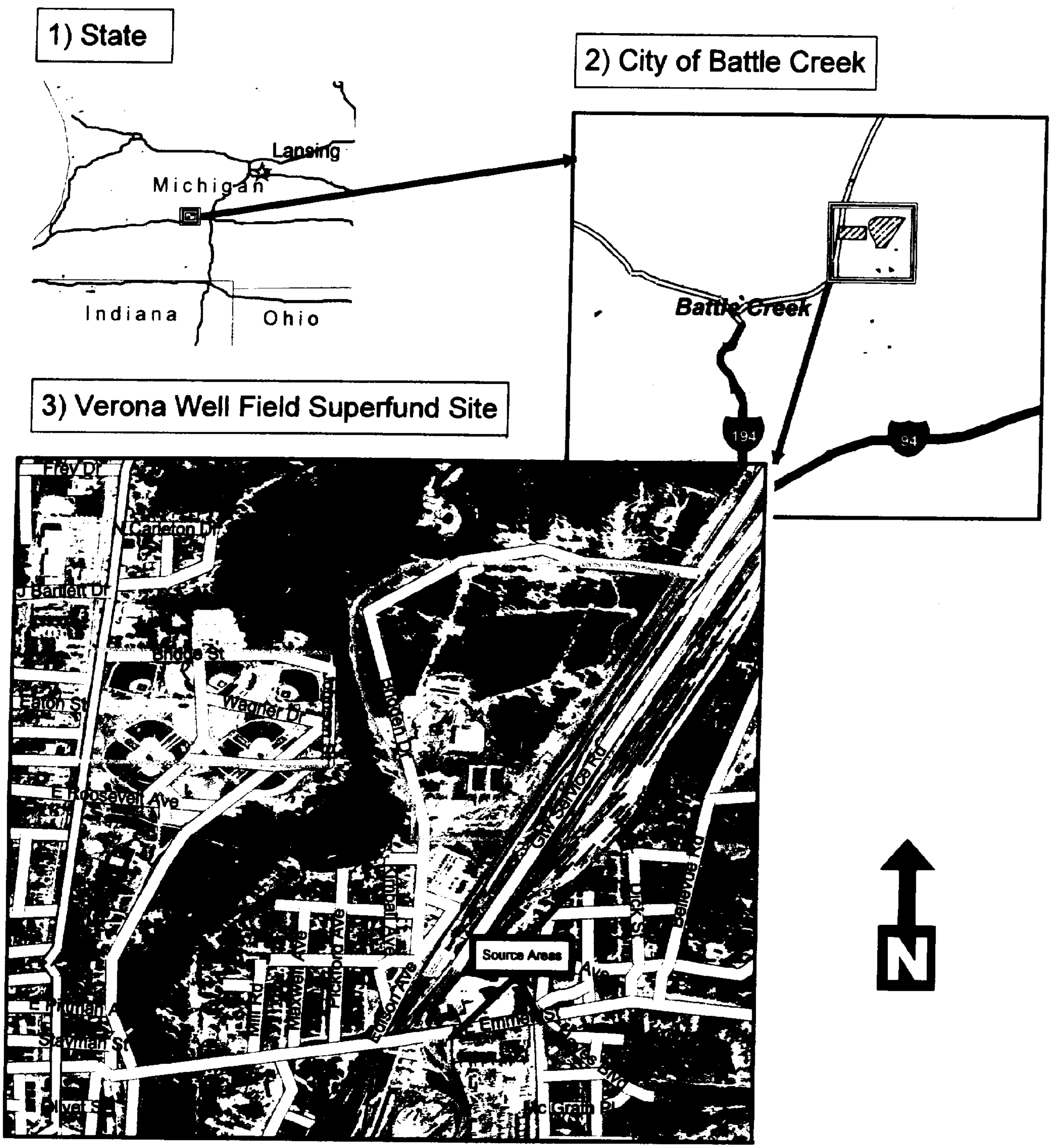
PARAMETER	ESD GW CUO	R9 GW PRG[1]	ESD SOIL CUO	R9 SOIL SSL/ PRG[2]
VOCs				
Acetone	730	610	14,600	16,000
Benzene	1	0.35	20	30
Carbon Tetrachloride	1	0.17	20	70
Chlorobenzene	100	110	2,000	900
Chloroform	1	0.73	1,540	2,740
1,1-Dichloroethane (1,1-DCA)	880	810	17,600	23,000
1,2-Dichloroethane	1	0.12	20	20
1,1-Dichloroethylene (1,1-DCE)	7	339	140	442,000
1,2-Dichloroethylene (cis)	70	61	1,400	400
1,2-Dichloroethylene (Trans)	100	120	2,000	700
Ethylbenzene	74	1,300	1,480	13,000
Methylene Chloride	5	4.3	100	20
Perchloroethylene (PCE or Tetrachloroethylene)	1.4	1.1	28	60
Toluene	790	720	16,000	12,000
1,1,1-Trichloroethane	200	540	4,000	2000
1,1,2-Trichloroethane	1	0.2	100	20
Trichloroethylene (TCE)	2.5	1.6	50	60
Vinyl chloride (VC)	1	0.041	20	10
Xylene	280	1,400	5,600	4,200
METALS				
Aluminum	300	36,000		
Antimony	6	15		

PARAMETER	ESD GW CUO	R9 GW PRG[1]	ESD SOIL CUO	R9 SOIL SSL/ PRG[2]
Arsenic	10	0.045		
Beryllium	4	73		
Cadmium	5	18		
Chromium	100	110		
Iron	2,000	11,000		
Lead	4	NONE		
Manganese	860	880		
Nickel	100	730		
Sodium	120,000			
SVOCs				
Bis(2-ethylhexyl)phthalate	5	4.8		
Hexachlorethane	5	4.8		
Nitrobenzene	5	3.4		
N-nitroso-di-n-propylamine	5	0.0096		

1. Water PRGs are from the Region 9 PRGs for tap water, except that the chloroform PRG was updated to account for updated toxicity factors added to IRIS.

2. The PRGs for residential soil and the SLS for a dilution attenuation factor of 20 were compared and the most stringent value tabulated above. The SLS were more stringent for all parameters except for chloroform, for which the residential soil PRG was more stringent. All values are from the November 22, 2000 update of the Region 9 PRG, except for chloroform, which was updated to account for updated toxicity factors added to IRIS.

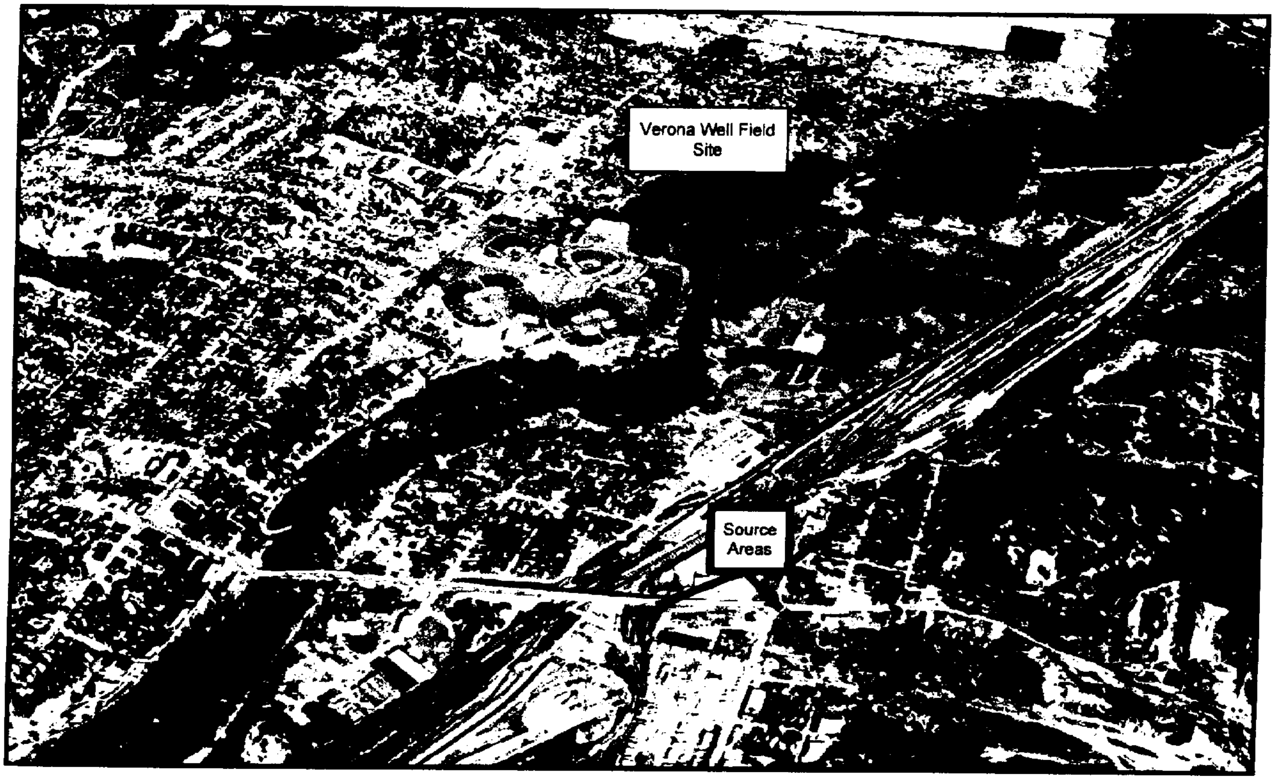
Verona Well Field Superfund Site
Calhoun County, Michigan

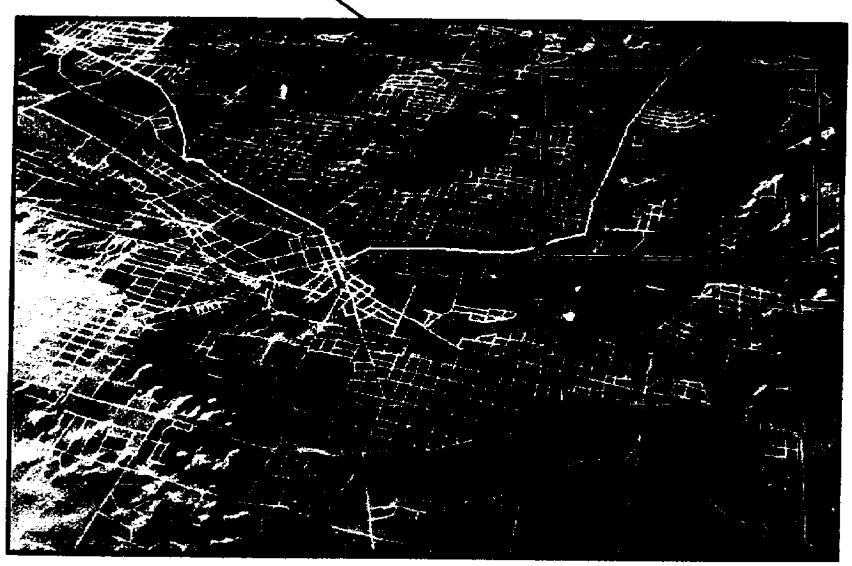


Plot created by David Wilson U.S. EPA Region 9/19/2002
Color Infra-Red Image Date 4/8/1999

Figure 1

Verona Well Field Superfund Site
3D Surface Terrain Model





Legend

Elevation Feet

- 980 - 1004
- 956 - 980
- 933 - 956
- 909 - 933
- 886 - 909
- 862 - 886
- 839 - 862
- 825 - 839
- 792 - 825

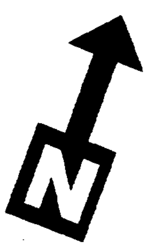
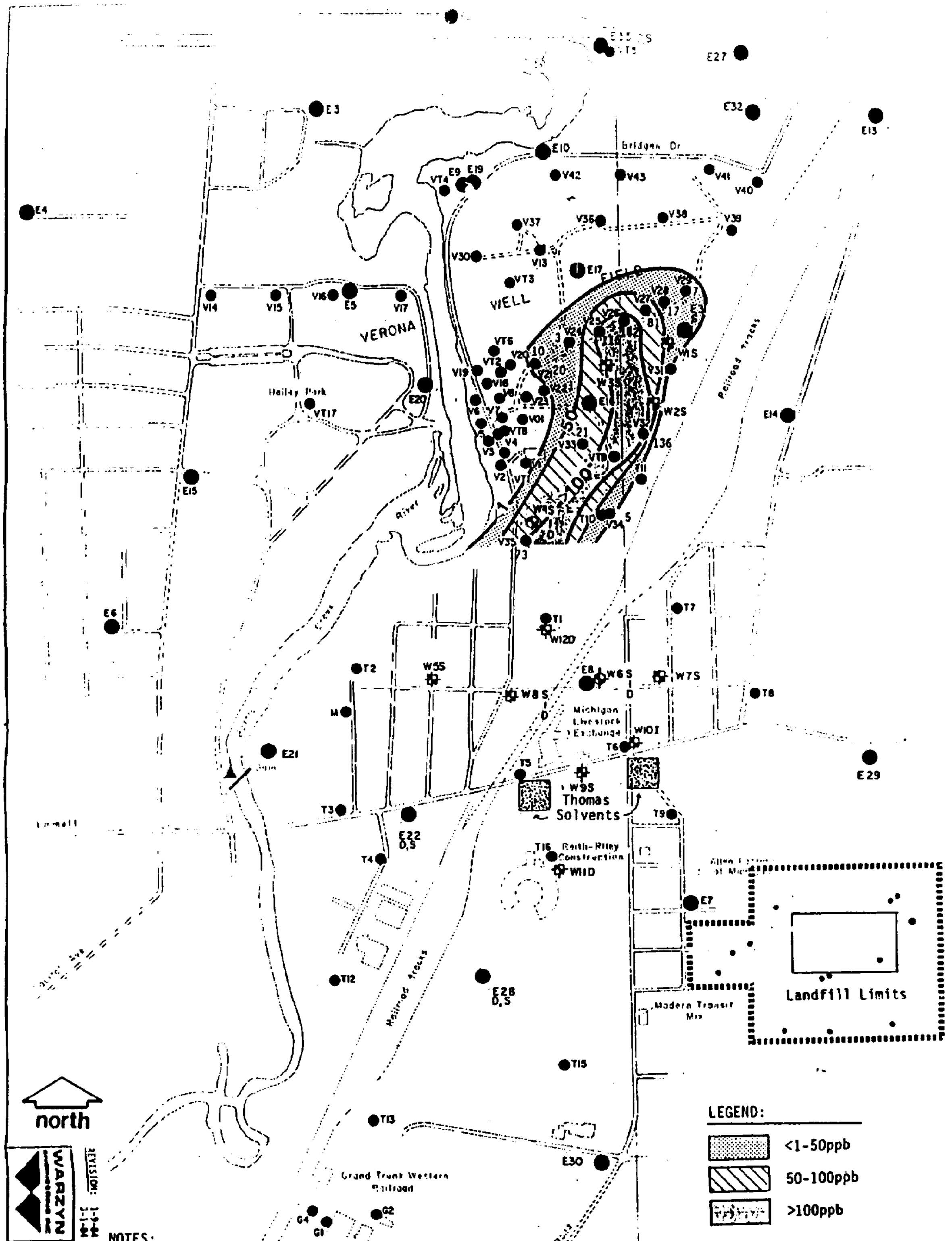


Figure 2

EPA

Region

Plot created by David Wilson U.S. EPA Region 5 on 8/4/2002
B&W Image Date 4/5/1998



NOTES:

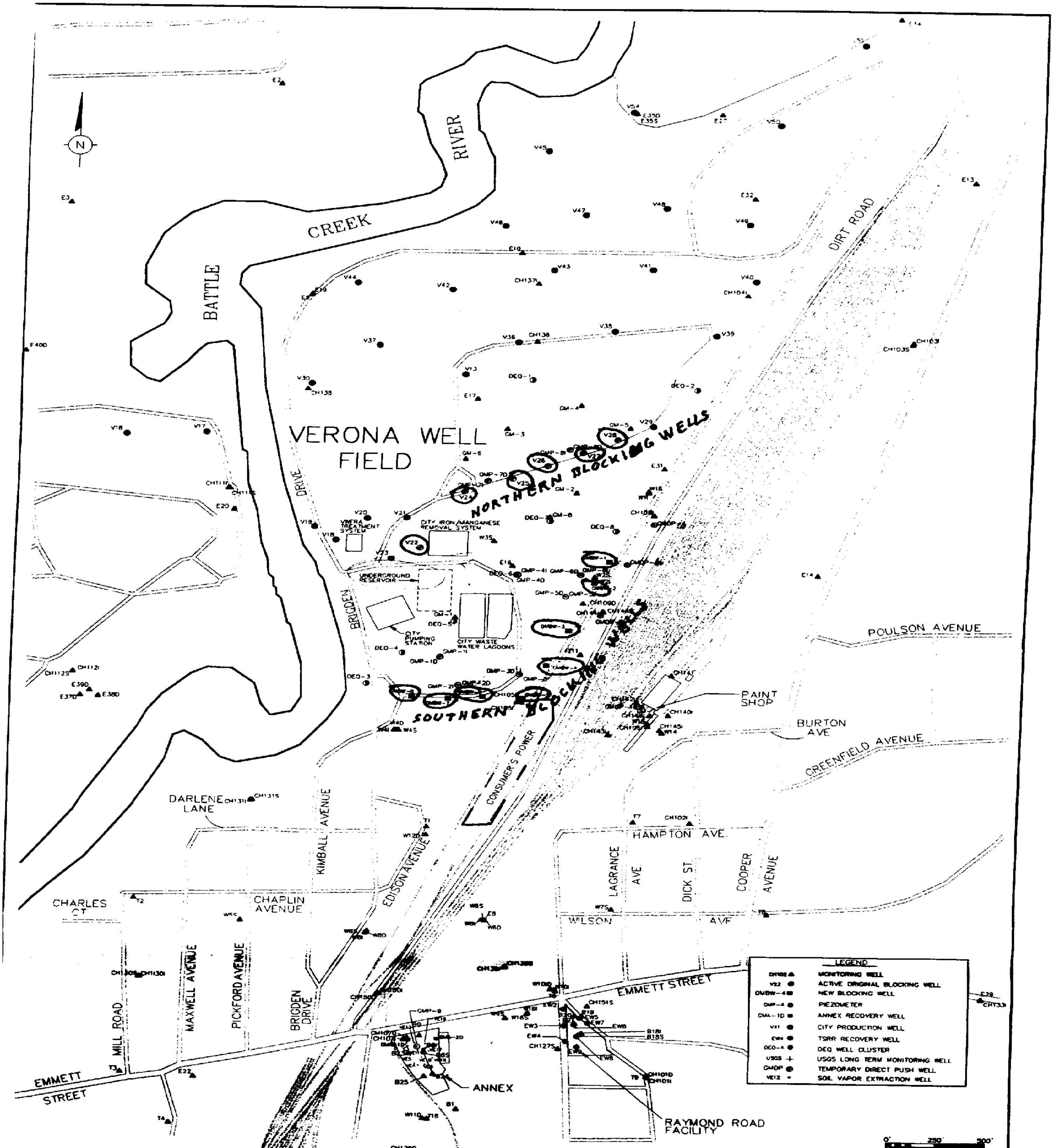
1. WATER QUALITY BASED ON ANALYSES AT ALL MUNICIPAL WELLS BETWEEN JANUARY AND APRIL, 1982.
2. CONCENTRATION RANGE IN ppb IS NOTED ADJACENT TO THE WELL. NO VALUE INDICATES LESS THAN DETECTION (1 ppb).
3. WATER QUALITY ANALYSES WERE OBTAINED FROM THE CITY OF BATTLE CREEK.
4. BASE MAP ADAPTED FROM USGS PLANIMETRIC MAP.

WARZYN

FIGURE 3-3

CONTAMINATED WELL FIELD AREA
TOTAL VOC 1/82 - 4/82
VERONA WELL FIELD-FFS

0000948



PROGRESSIVE ENGINEERING & CONSTRUCTION, INC

7827 North Dale Mabry Hwy, Suite 104
Tampa, Florida 33614
Phone (813) 930-0669
Fax (813) 930-0000

SITE PLAN

VERONA WELL FIELD

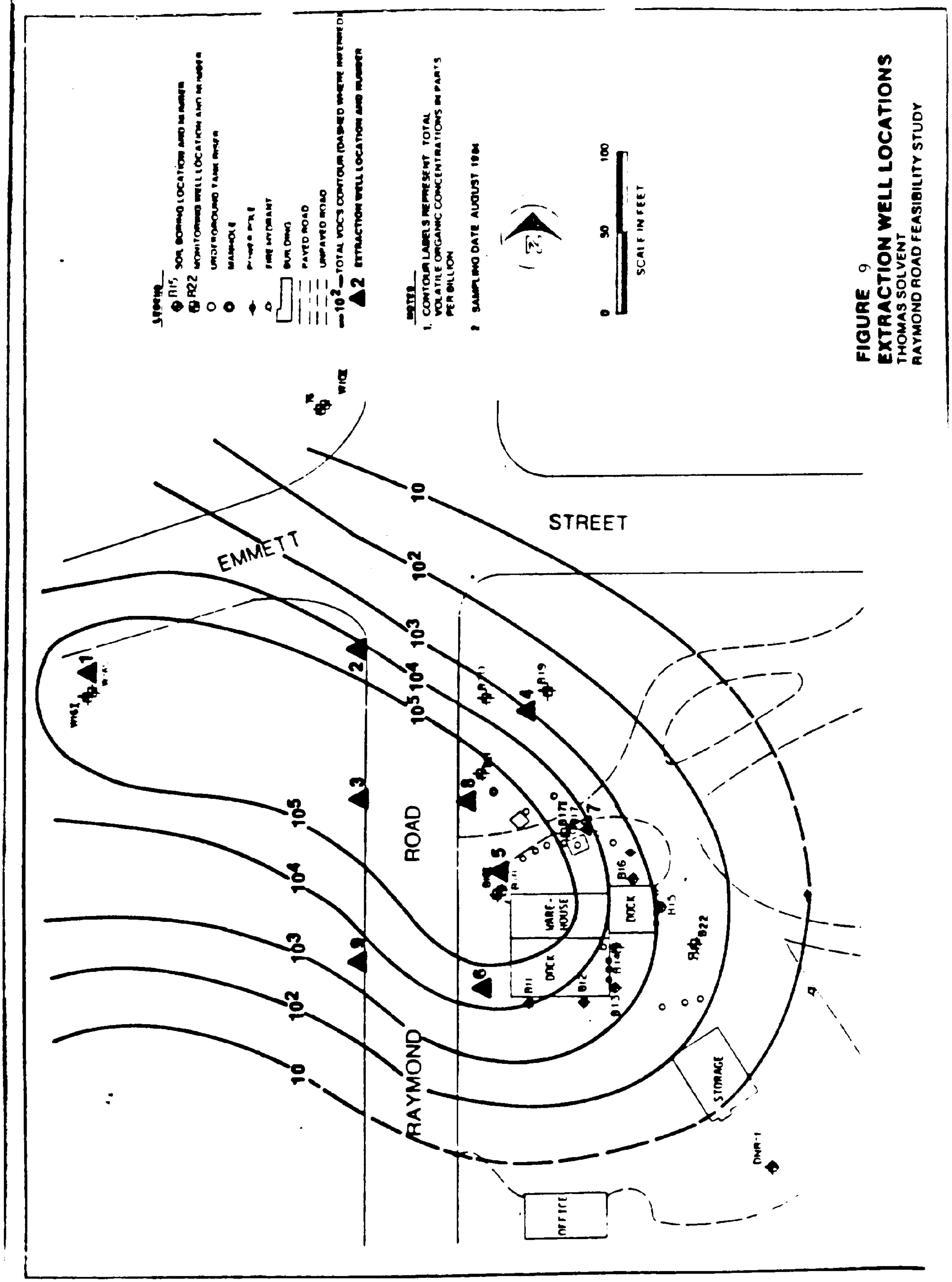
DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
HWB	1/18/2000	BM	GJR

REV.	DATE	DESCRIPTION
00	1/13/00	ADD GM-8, GMDP-1,2,3&4

LEAD DESIGN PROF.	CHECKED
BSM	BSM

PROJECT NUMBER	DRAWING NUMBER
P-1001	1

FIGURE 9



LEGEND
SOIL BORING LOCATION AND NUMBER
MONITORING WELL LOCATION AND NUMBER
UNDERGROUND TANK RISER
MANHOLE
POWER POLE
FIRE HYDRANT
BUILDING
PAVED ROAD
UNPAVED ROAD
TOTAL VOC'S CONTOUR (DASHED WHERE INFERRED)
EXTRACTION WELL LOCATION AND NUMBER
NOTES
1. CONTOUR LABELS REPRESENT TOTAL VOLATILE ORGANIC CONCENTRATIONS IN PARTS PER BILLION
2. SAMPLING DATE AUGUST 1984
0 50 100
SCALE IN FEET
EMMETT STREET
RAYMOND ROAD
WAREHOUSE
DOCK
STORAGE
OFFICE
FIGURE 9
EXTRACTION WELL LOCATIONS
THOMAS SOLVENT
RAYMOND ROAD FEASIBILITY STUDY

[9/27/02 DRAFT. CONTAMINANTS FOR DISCUSSION ARE BOLDED]
2002 ESD TABLE 1

Verona Well Field, Battle Creek, Michigan
Derivation of Updated Groundwater and Soil Cleanup Objectives (CUOs)
(in micrograms/liter for ground water and micrograms per kilogram for soil)

VOC of Known Concern in Ground Water	1991 ROD CUO	TDL[1]	Cancer Risk Goal[2]	Non-Cancer Risk Goal[2]	MCL[3]	Michigan Criteria[4]	New CUO[5]
Acetone	700	100	--	768	--	730	730
Benzene	1	1	0.54	14	5	5	1
Carbon tetrachloride	--	1	0.26	5	--	5	1
Chlorobenzene	100	1	--	135	100	100	100
Chloroform	**6**	**1**	**0.73**	**0.73**	**100**	**100**	**1**
1,1-Dichloroethane	1	1	--	1008	--	880	880
1,2-Dichloroethane	1	1	0.2	13	5	5	1
1,1-Dichloroethylene	**1**	**1**	–	**339**	**7**	**7**	**7**
cis-1,2-Dichloroethylene	1	1	–	77	70	70	70
trans-1,2-Dichloro-ethylene	100	1	–	154	100	100	100
Ethylbenzene	70	1	--	1,592	700	74	74
Methylene Chloride	5	5	6.2	1,735	5	5	5

TABLE 1 CONTINUED							
VOC of Kown Concern in Ground Water	**1991 ROD CUO**	**TDL**	**Cancer Risk Goal**	**Non-Cancer Risk Goal**	**MCL**	**Michigan Criteria**	**New CUO**
Tetrachloroethylene or Perchloroethylene (PCE)	1	1	1.4	275	5	5	1.4
Toluene	800	1	--	934	1,000	790	790
1,1,1-Trichloroethane	200	1	--	578	200	200	200
1,1,2-Trichloroethane	1	1	0.32	31	5	5	1
Trichloroethylene (TCE)	3	1	2.5	46	5	5	2.5
Vinyl Chloride (VC)	1	1	0.1	79	2	2	1
Xylene	300	3	--	1,896	10,000	280	280
SVOCs and Metals of Concern in Ground Water							
Aluminum	NONE	50	--	36,000	--	300[6]	300
Antimony	3	5	--	15	6	6	6
Arsenic	0.02	10	0.045	--	10	50	10
Beryllium	NONE	1	--	73	4	4	4
Cadmium	4	0.5	--	18	5	5	5
Chromium	100	5	--	110	100	100	100
Iron	NONE	100	--	11,000	--	2000[6]	2000

TABLE 1 CONTINUED

SVOC or Metal of Concern in Ground-Water	1991 ROD CUO	TDL	Cancer Risk Goal	Non-Cancer Risk Goal	MCL	Michigan Criteria	New CUO
Lead	NONE	3	--	--	15	4	4
Manganese	700	20	--	880	--	860[6]	860
Nickel	100	25	--	730	--	100	100
Sodium	NONE	1000	--	--	--	120,000	120,000
Bis(2-ethylhexyl)phthalate	2	5	4.8	--	6	6	5
Hexachloroethane	2	5	4.8	--	--	7.3	5
Nitrobenzene	4	5	--	3.4	--	3.4	5
N-nitroso-di-n-propylamine	0.005	5	0.0096	--	--	5	5

VOC of Known Concern in Soil	1991 ROD CUO	Soil TDL[1]	TCLP Estimate[7]	Michigan Criteria[8]	New CUO
Acetone	14,000	100	14,600	15,000	14,600
Benzene	20	10	20	100	20
Carbon Tetrachloride	10	10	20	100	20
Chlorobenzene	2,000	10	2,000	2,000	2,000
Chloroform	**--**	**10**	**2,740**	**2,000**	**2,000**

TABLE 1 CONTINUED					
VOC of Known Concern in Soil	**1991 ROD CUO**	**Soil TDL**	**TCLP Estimate**	**Michigan Criteria**	**New CUO**
1,1-Dichloroethane (1,1-DCA)	20	10	17,600	18,000	17,600
1,1-Dichloroethylene	**10**	**10**	**442,000**	**140**	**140**
1,2-Dichloroethane	10	10	20	100	20
cis-1,2-Dichloroethylene (cis-1,2-DCE)	20	10	1,400	1,400	1,400
trans-1,2-Dichloroethylene	2,000	10	2,000	2,000	2,000
Ethylbenzene	1,400	10	1,480	1,500	1,480
Methylene Chloride	100	10	100	100	100
Tetrachloroethylene or Perchloroethylene (PCE)	10	10	28	100	28
Toluene	16,000	10	15,800	16,000	15,800
1,1,1-Trichloroethylene	4,000	10	4,000	4,000	4,000
1,1,2-Trichloroethane	10	10	20	100	20
Trichloroethylene (TCE)	60	10	50	100	50
Vinyl Chloride	--	10	20	40	20
Xylenes	6,000	30	5,600	5,600	5,600

1. Except for arsenic TDLs are target detection limits from "Environmental Response Division Operational Memorandum #6, Revision 5, Analytical Method Detection Level Guidance for Environmental contamination Response Activities under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act", MDEQ, November 16, 1998. However, for arsenic the MDEQ target detection limit (20 ug/l) is designed for providing reliable quantitation at 50 ug/l. Since the MCL has been revised to 10 ug/l, a TDL of 20 ug/l is unacceptable. Therefore, for arsenic the TDL is set equal to the practical quantitation level from Appendix IX of 40CFR264 for method 7060 from SW846. The practical quantitation level is the lowest concentration in ground-waters that can be reliably determined.

2. The Cancer Risk Goals correspond to the 1 X 10^{-6} carcinogenic risk level for lifetime exposure via ingestion and inhalation of the contaminant resulting from residential water usage. Dashed lines mean that the parameter is not considered to be carcinogenic. The Non-Cancer Risk Goals are concentrations in water that would result in an exposure rate equal to the reference dose for health effects other than cancer due to ingestion and inhalation of the contaminant from residential water usage. Dashed lines mean that the parameter is Cancer Risk Goal column means that the contaminant is not considered to be carcinogenic. Dashed lines in the Non-Cancer Risk Goal column means that the contaminant is carcinogenic and that the Cancer Risk Goal is more stringent than the Non-Cancer Risk Goal. The toxicity factors generally reflect those used for calculation of the November 22, 2000 update of the Region 9 PRGs. However, toxicity factors were updated in IRIS for chloroform on 10/19/01, and for 1,1-DCE on 8/13/2002.

For VOCs other than chloroform and 1,1-DCE in ground-water and soil, the Cancer Risk Goals, and Non-Cancer Risk Goals are from calculations conducted by Progressive in letter dated September 13, 2002. These numbers differ from the Region 9 PRGs because of slightly different assumptions used for assessing potential exposure to VOCs in tap water via inhalation. For SVOCs and metals in ground-water, these numbers are from the EPA Region 9, PRG Tables updated on November 22, 2000 (www.epa.gov/region09/waste/sfund/prg). Inasmuch as inhalation exposures to SVOCs and metals from tap water are insignificant, there should be no difference between the calculation procedures used by Progressive and the procedures used for the Region 9 PRGs for metals and SVOCs. For chloroform, EPA Region 5 recalculated the PRG using updated toxicity factors.

For chloroform and 1,1-DCE, EPA Region 5 staff calculated updated PRGs using Region 9 procedures and assumption, but with the updated toxicity factors. The Non-Cancer Risk Goal calculated by EPA for chloroform differs from that calculated by Progressive, because EPA used the reference doses used by Region 9: Rf_o= 0.01, and Rf_i= 0.0001, while Progressive assumed that Rf_o= Rf_i= 0.01. .

IRIS states that the Rf_o (0.01 mg/kg/d) is also protective for cancer risks, but does not include an Rf_i. **[The parties can further investigation what Rf_i should be used for chloroform before the ESD is finalized]**

Public comments on an EPA draft toxicity assessment proposing to update the toxicity factors for trichloroethylene is now under review by EPA. IRIS has withdrawn cancer potency factors from IRIS, but no updated factors are available. Therefore, the old TCE toxicity factors were used for calculation of the Cancer Risk Factor for TCE.

3. Safe Drinking Water Act Maximum Contaminant Levels. Dashed lines indicate that no MCL has been established for the parameter.

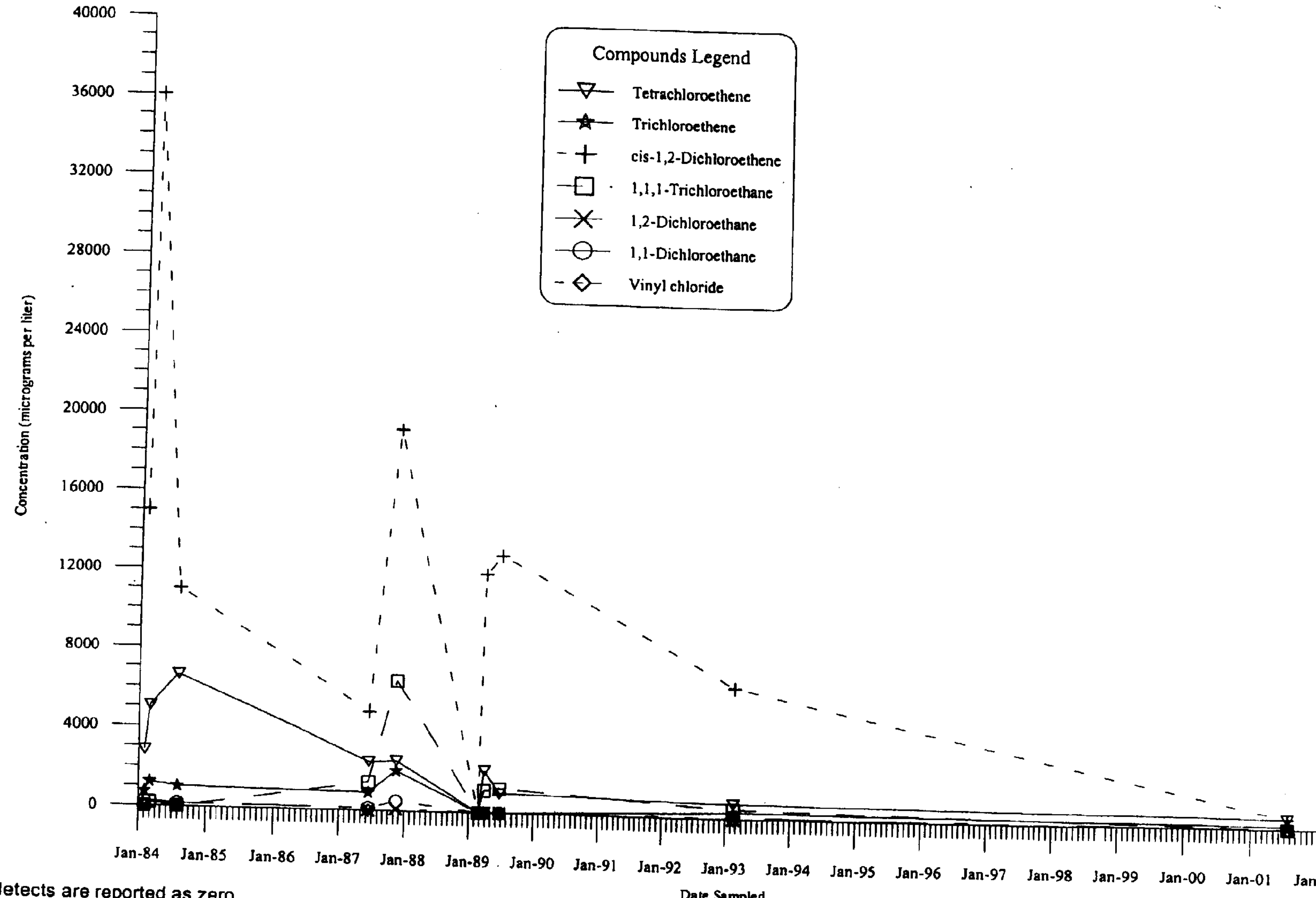
4. Generic criteria for residential and commerical I drinking water from "Envrionmental Response Division Operational Memorandum #18, Part 201 Generic Cleanup Criteria Tables, Revision 1", MDEQ, June 7, 2000.

5. For inorganic contaminants, the CUO will be background if background is determined to exceed the value in this column.

6. The criteria for aluminum, iron and manganese are the residential health-based drinking water criteria from footnote {E} of the generic criteria tables. These are less stringent than the aesthetic criteria actually included in the tabulation.

7. The TCLP (toxicity characteristics leaching procedure) Estimate for each parameters is the concentrations in soil that could potentially leach into the liquid phase during a TCLP test at a concentration equal to the ground-water CUOs.

8. Generic criteria for drinking water protection for Soil: Residential and Commercial I from "Environmental Response Division Operational Memorandum #18, Part 201 Generic Cleanup Criteria Tables, Revision 1", MDEQ, June 7, 2000. As an alternative to use of these total soil concentrations, the SPLP test may be run and the concentration in the extract compared directly to the Generic Residential Cleanup Criteria for Groundwater.



Non-detects are reported as zero.

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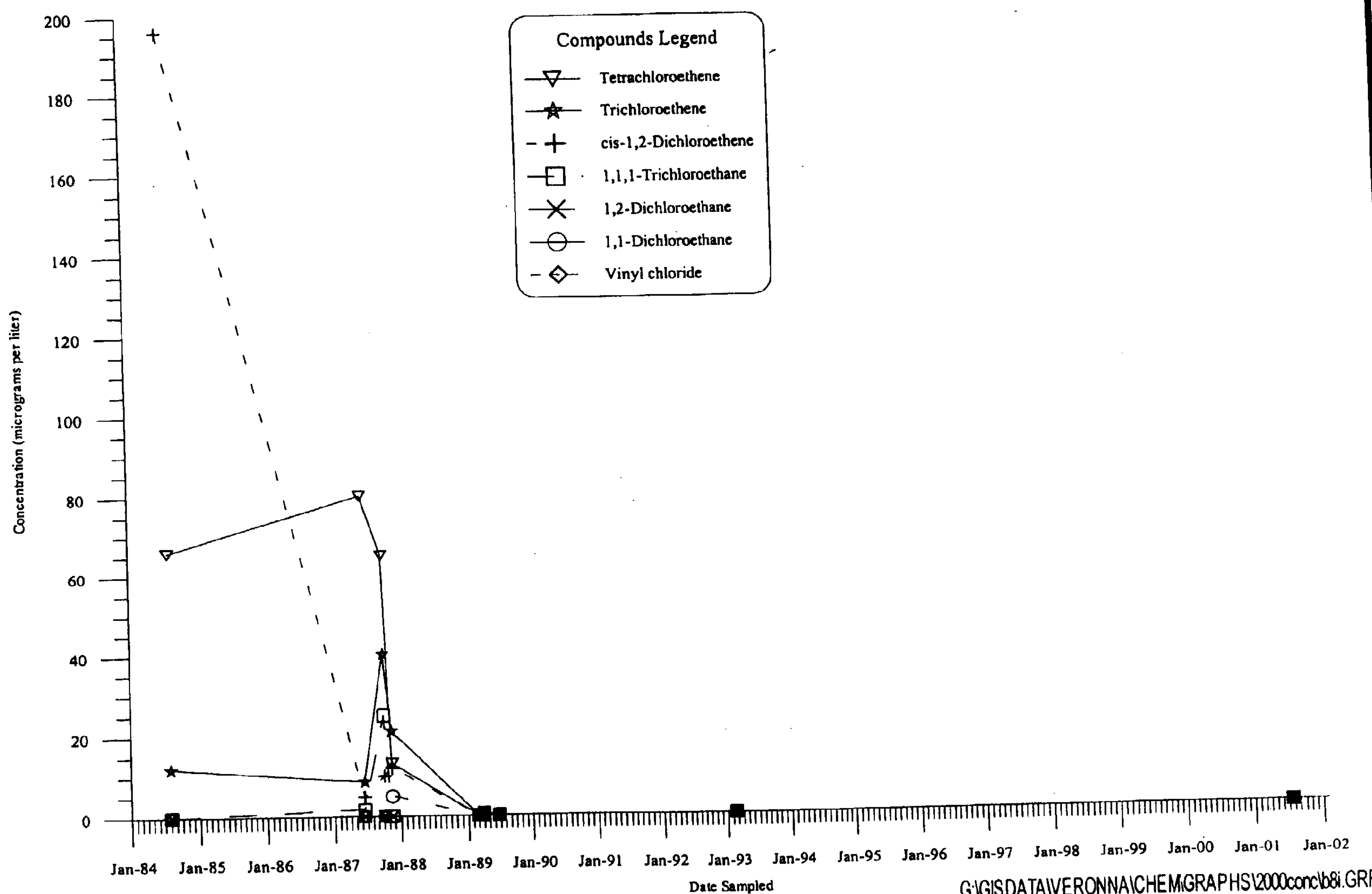
Concentration of Compounds Detected in Well B-8S at the Veronna Well Field Site through August 2001

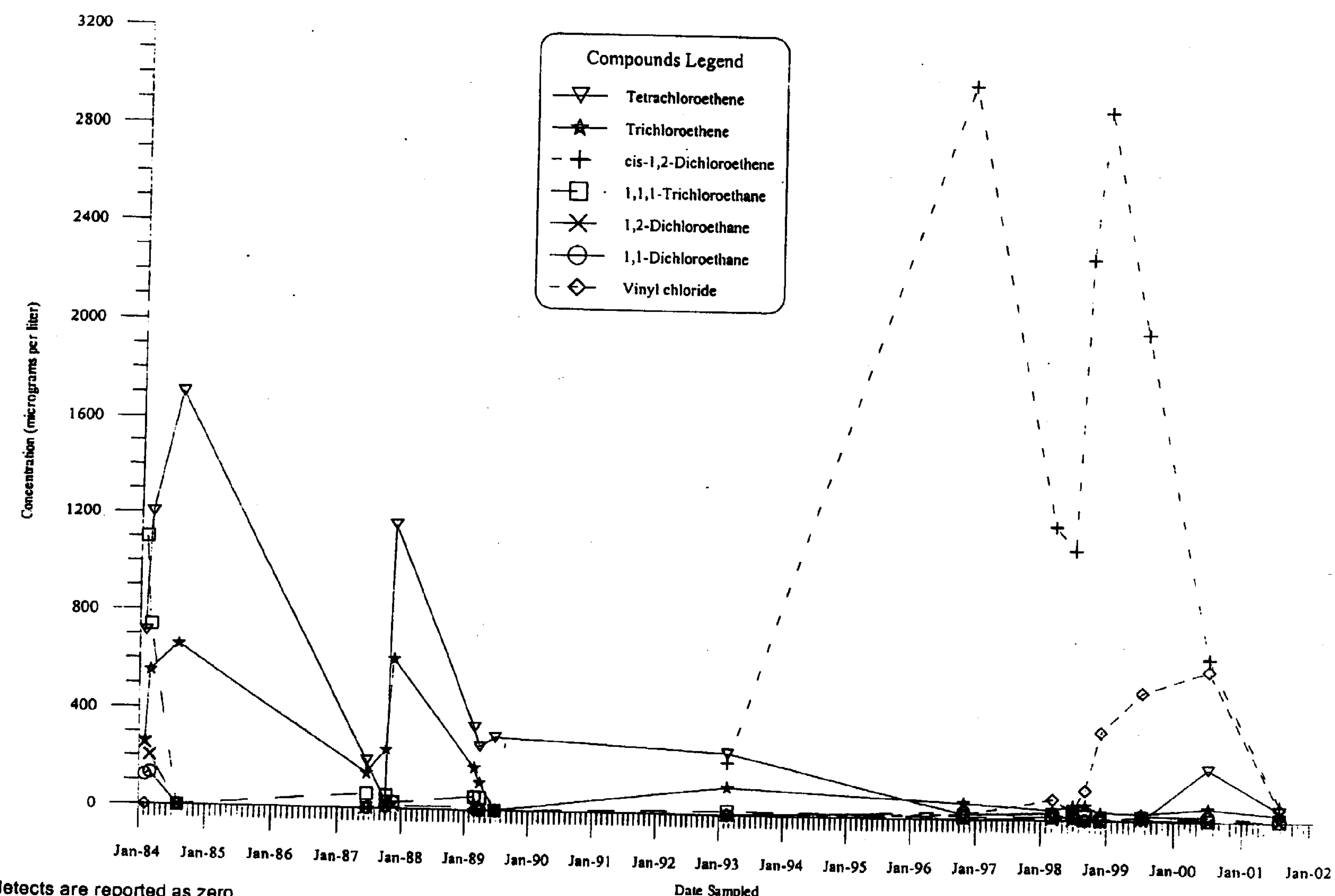
FIGURE 1



Non-detects are reported as zero.

Concentration of Compounds Detected in Well B-8I at the Veronna Well Field Site through August 2001

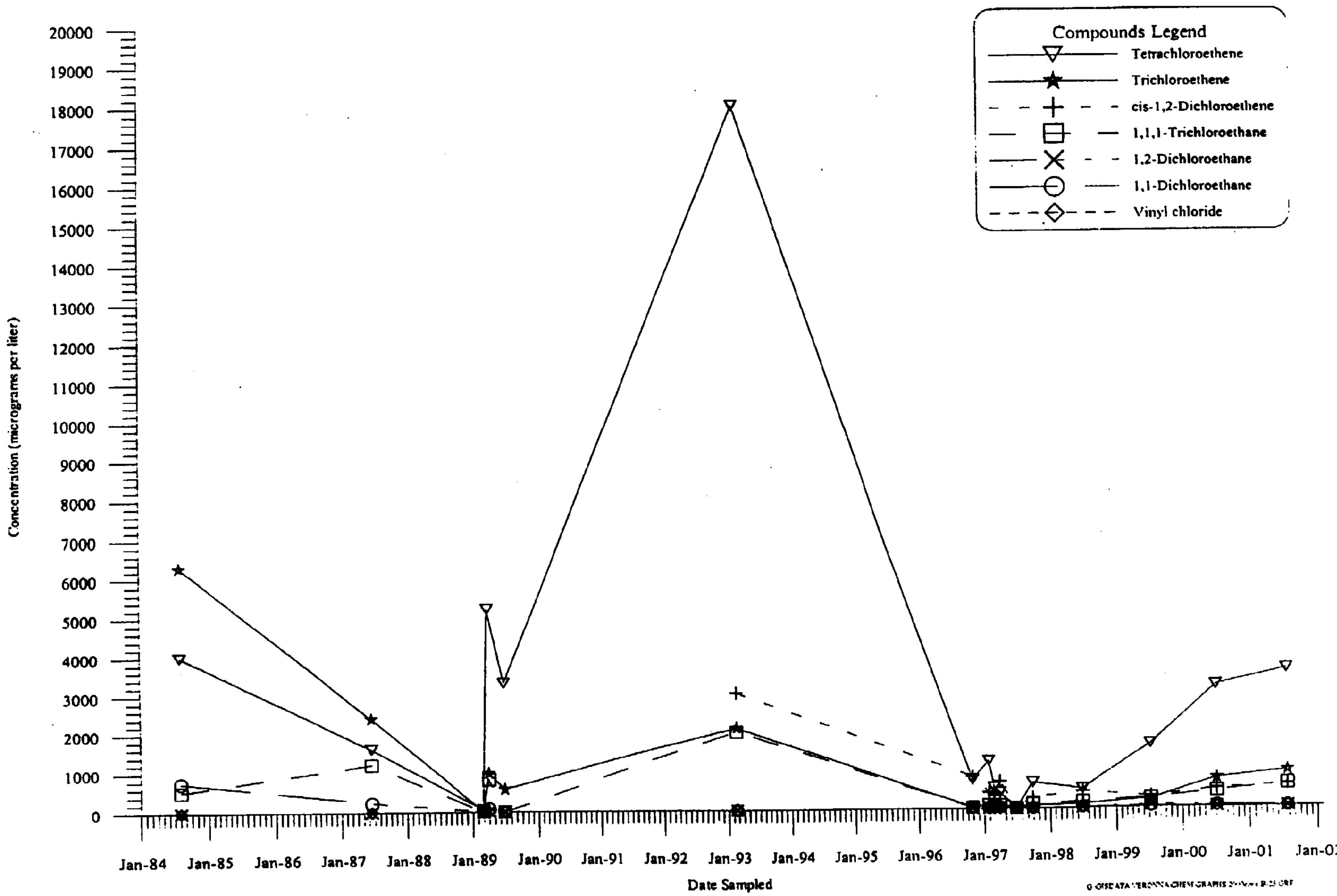
FIGURE 2



Non-detects are reported as zero.

Concentration of Compounds Detected in Well B-9 at the Veronna Well Field Site through August 2001

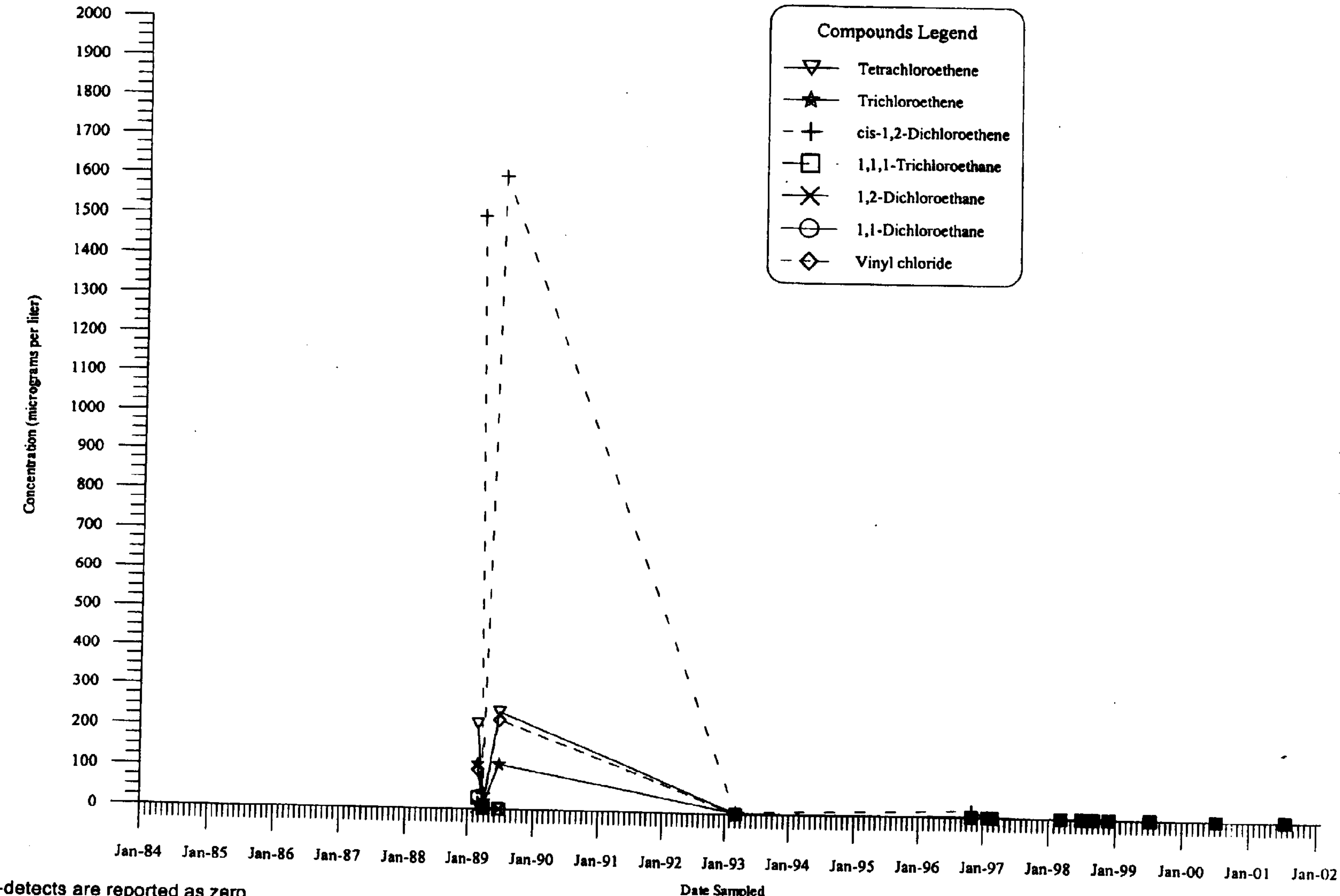
FIGURE 3



Non-detects are reported as zero.

Concentration of Compounds Detected in Well B-25 at the Veronna Well Field Site through August 2001

FIGURE 4



Non-detects are reported as zero.

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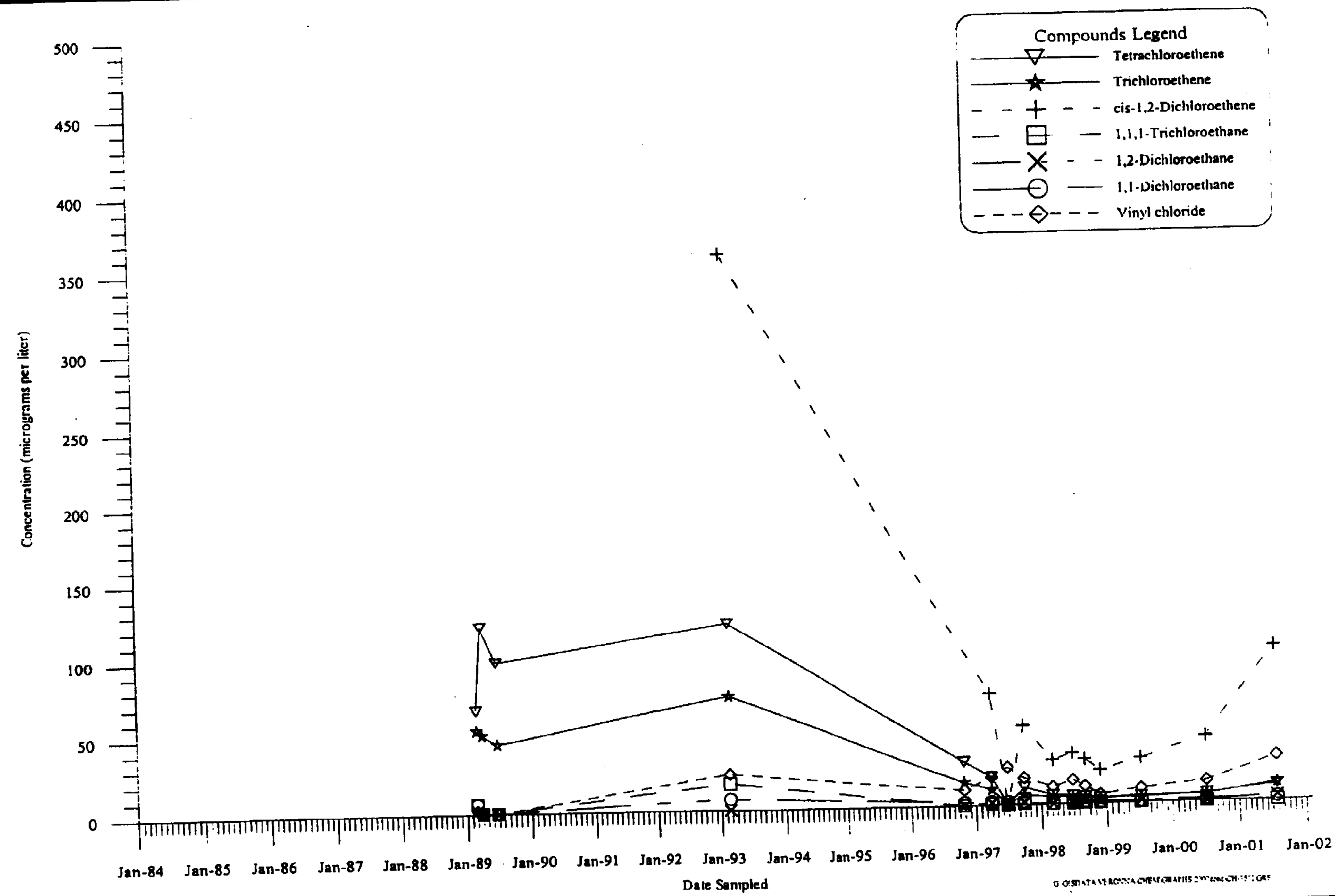
Concentration of Compounds Detected in Well CH-107I at the Veronna Well Field Site through August 2001

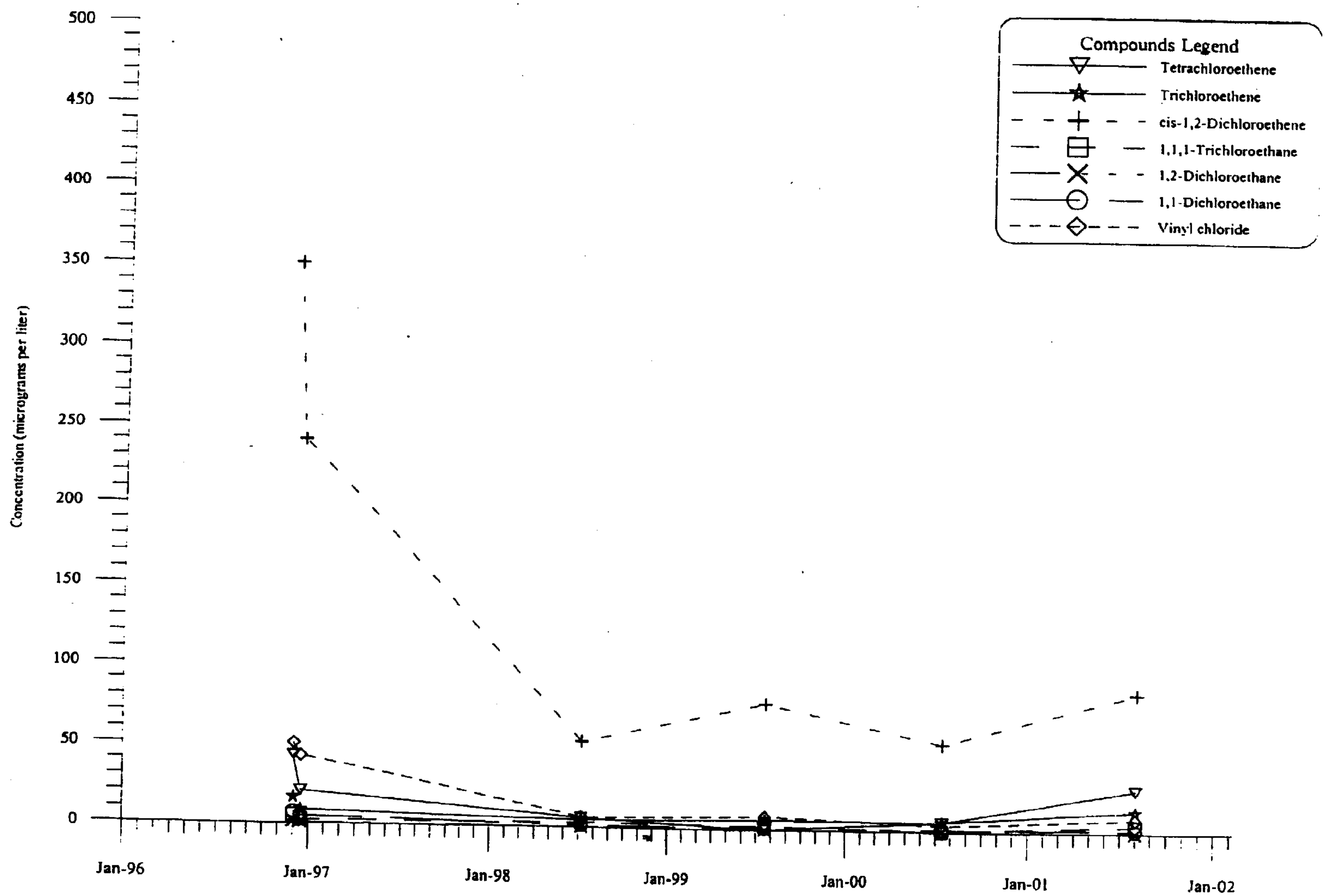
FIGURE 5



Non-detects are reported as zero.

Concentration of Compounds Detected in Well CH-150I at the Veronna Well Field Site through August 2001

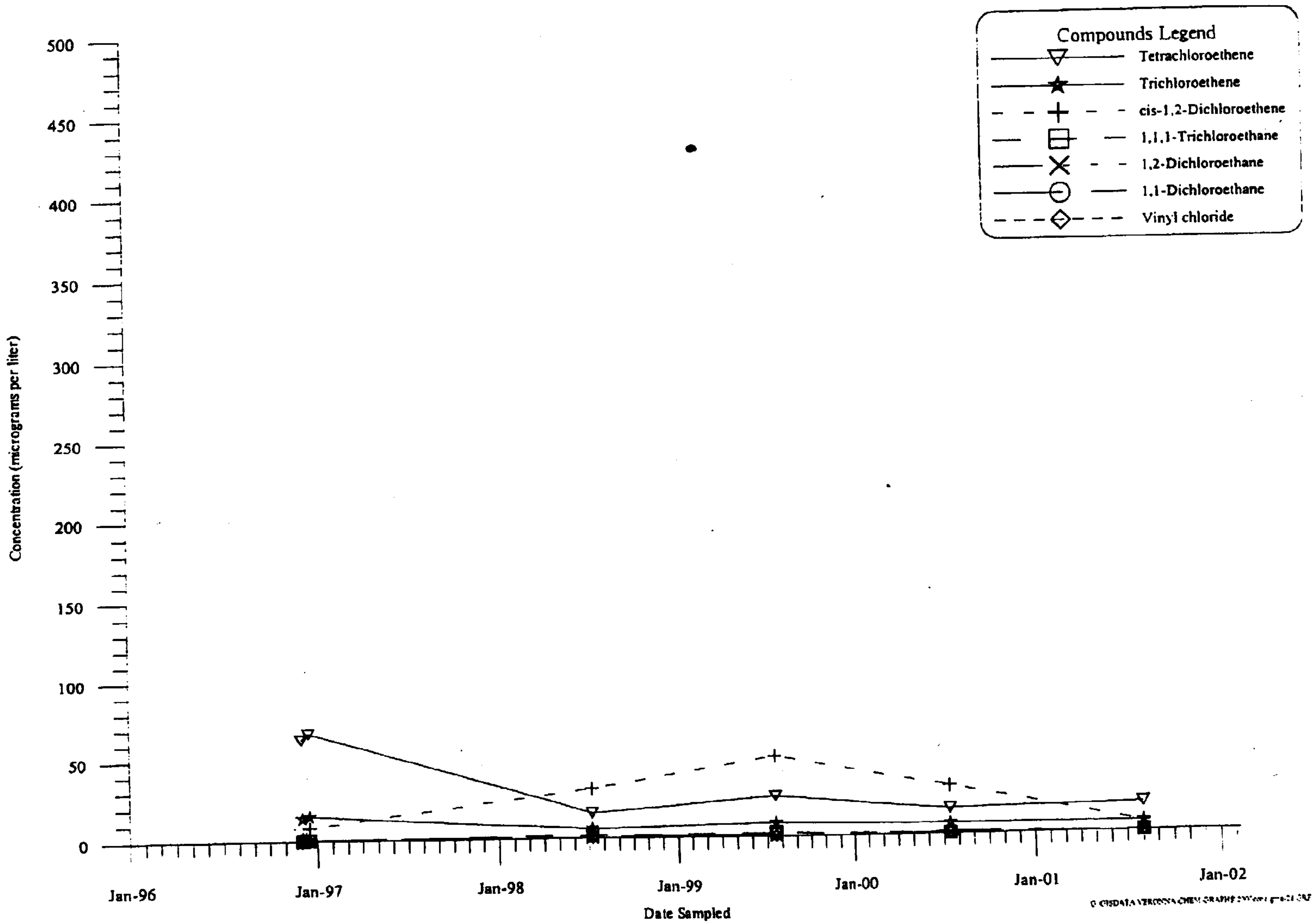
FIGURE 6



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GMA-1D at the Veronna Well Field Site through August 2001

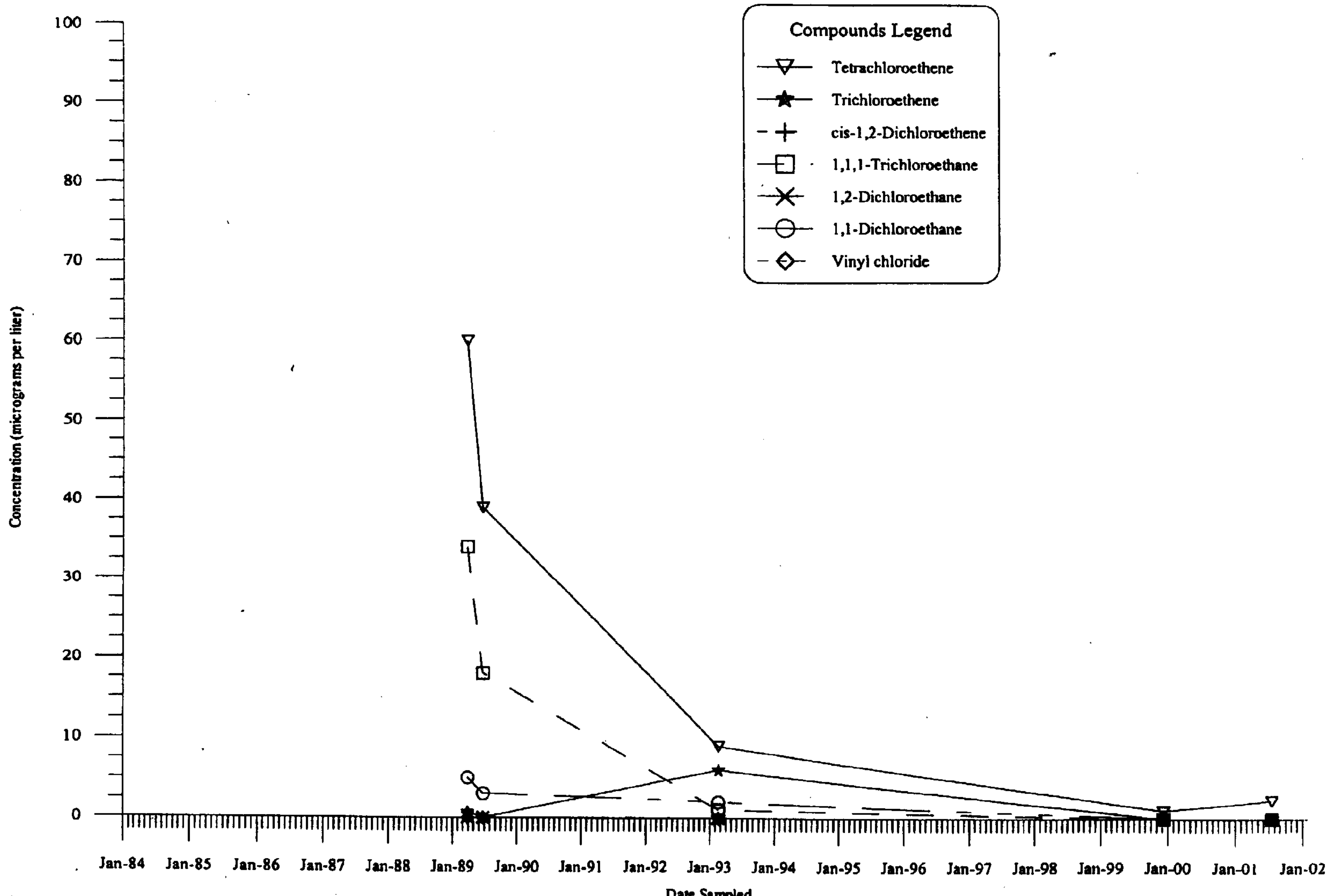
FIGURE 7



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GMA-2D at the Veronna Well Field Site through August 2001

FIGURE 8



Non-detects are reported as zero.

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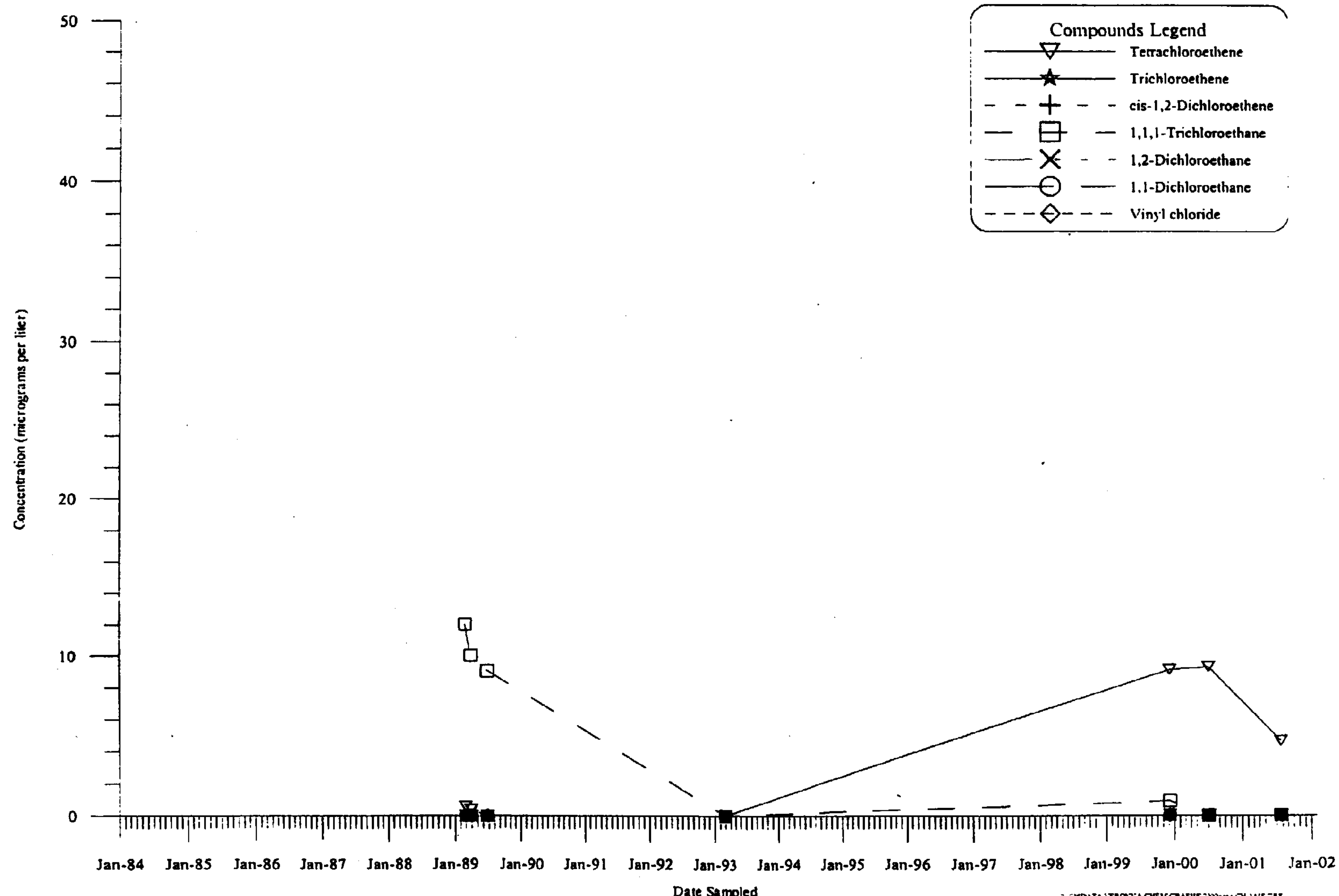
Concentration of Compounds Detected in Well CH-108I at the Veronna Well Field Site through August 2001

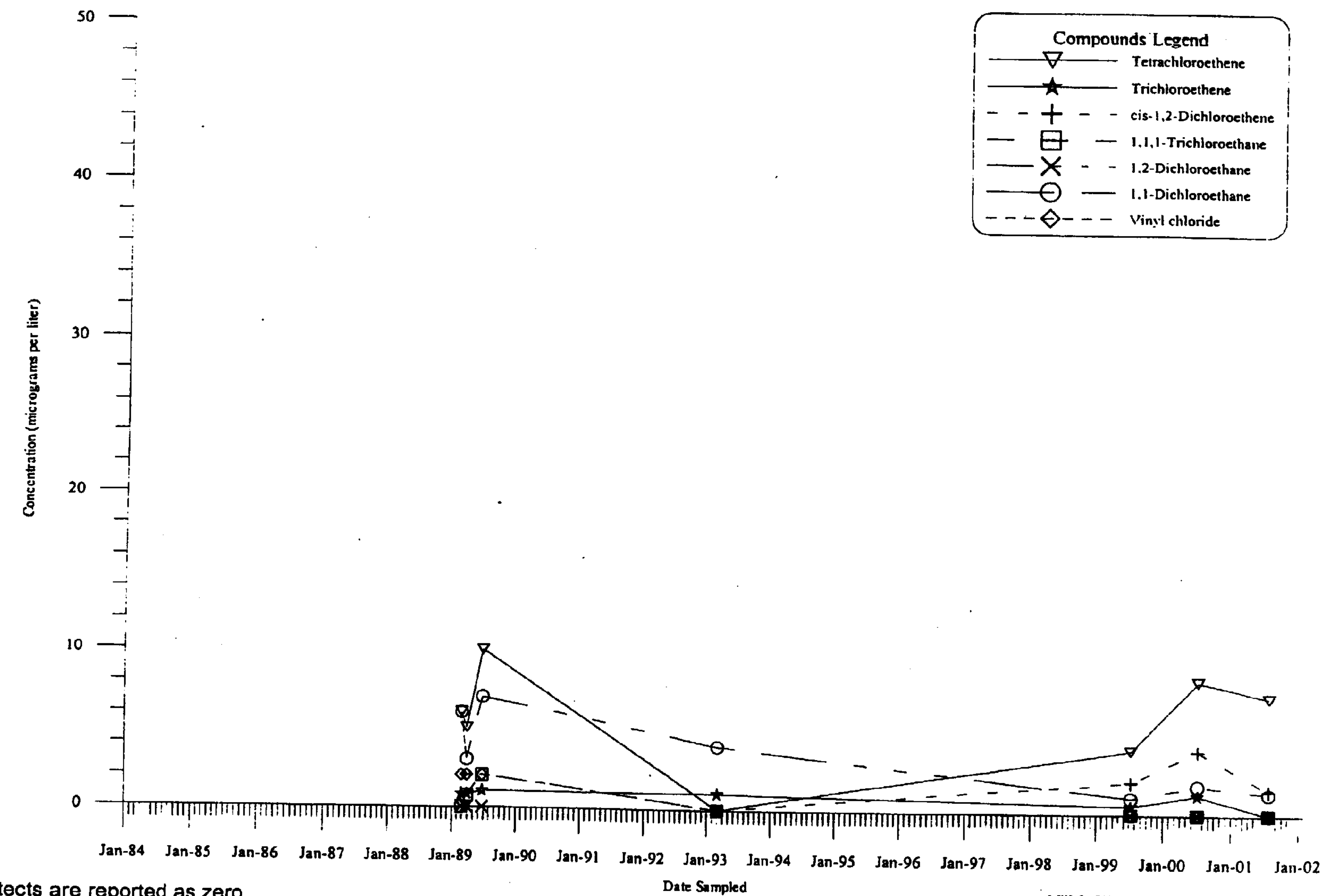
FIGURE 9



Non-detects are reported as zero.

Concentration of Compounds Detected in Well CH-144S at the Veronna Well Field Site through August 2001

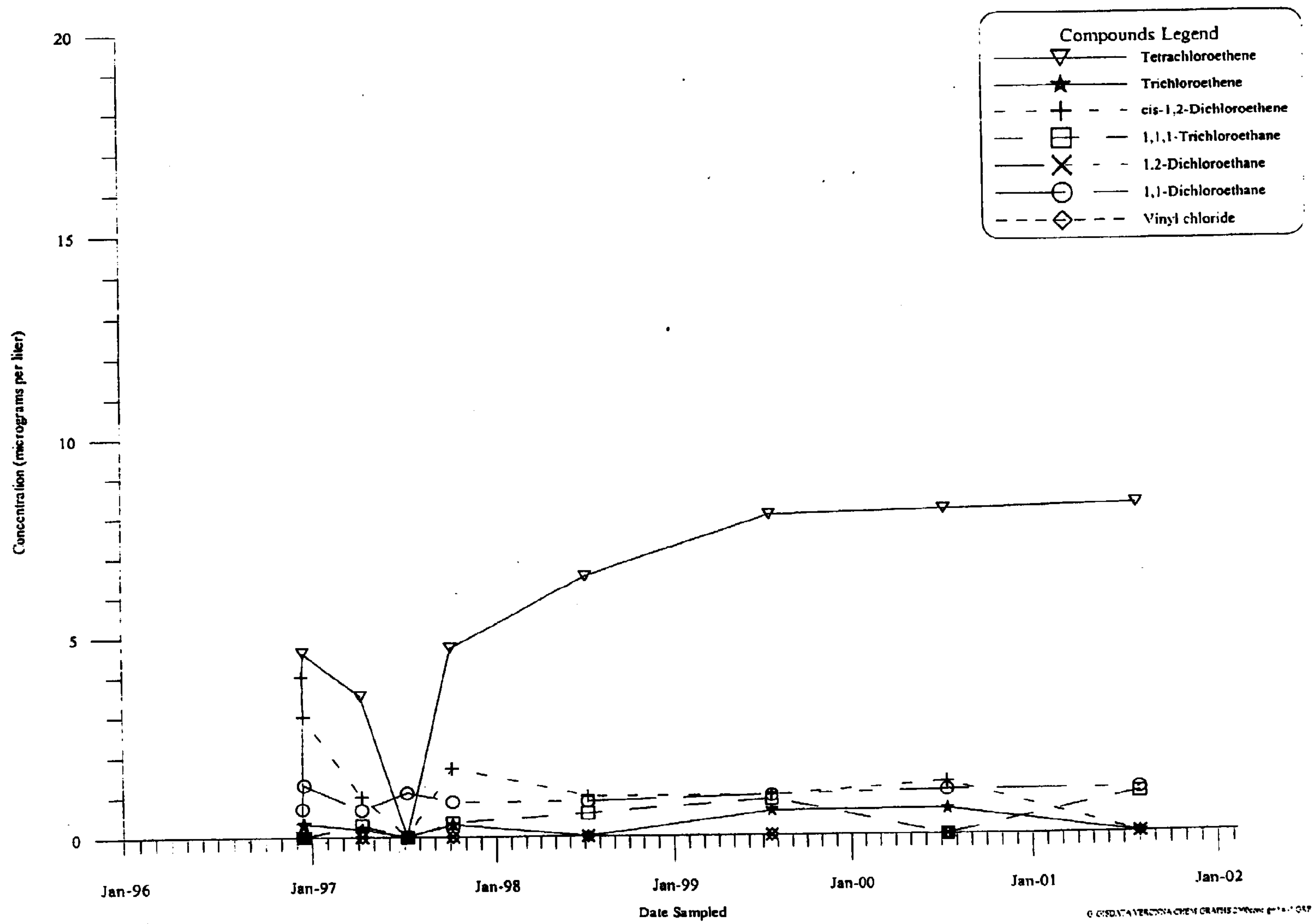
FIGURE 10



Non-detects are reported as zero.

Concentration of Compounds Detected in Well CH-144I at the Veronna Well Field Site through August 2001

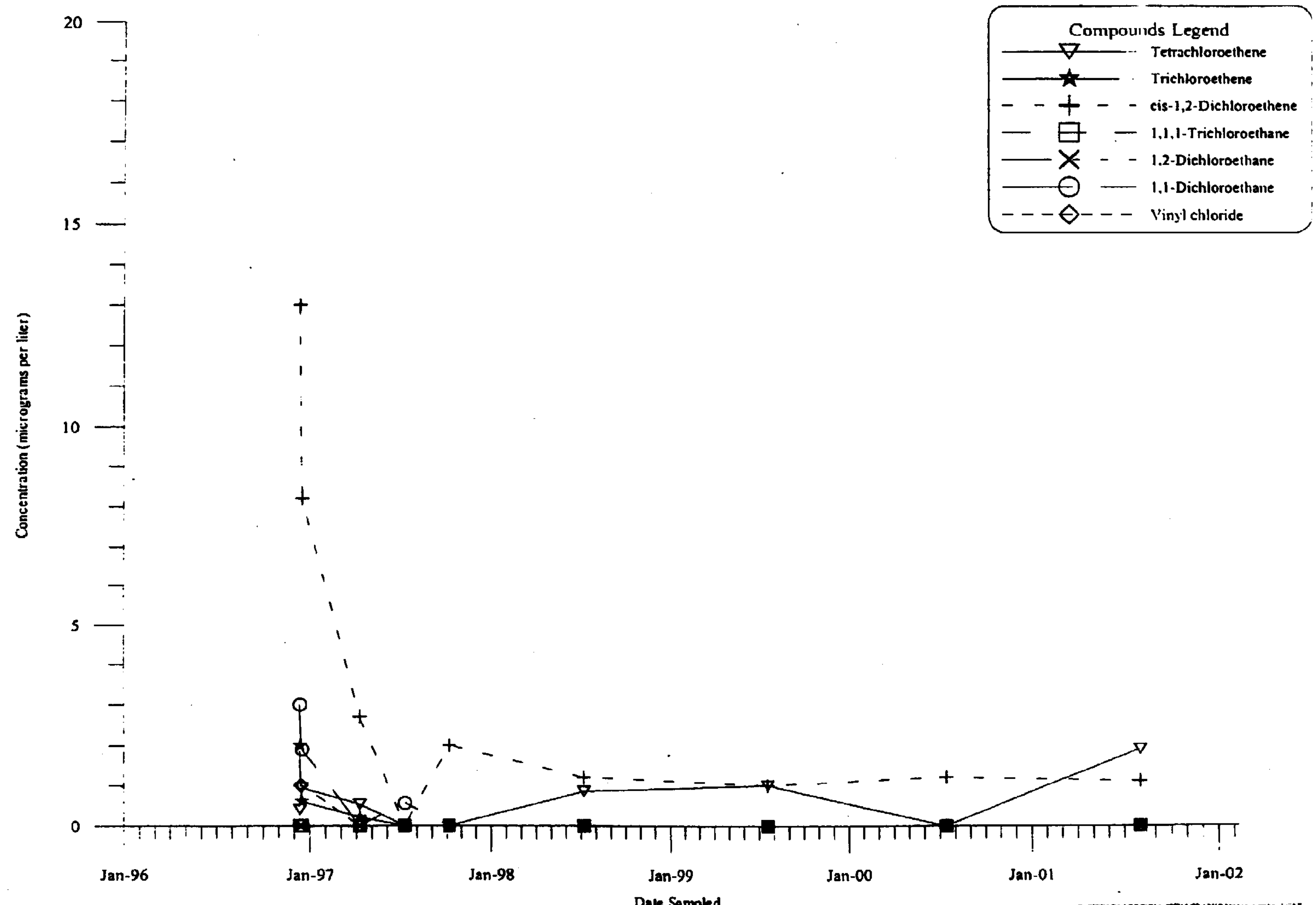
FIGURE 11



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GMBW-1 at the Veronna Well Field Site through August 2001

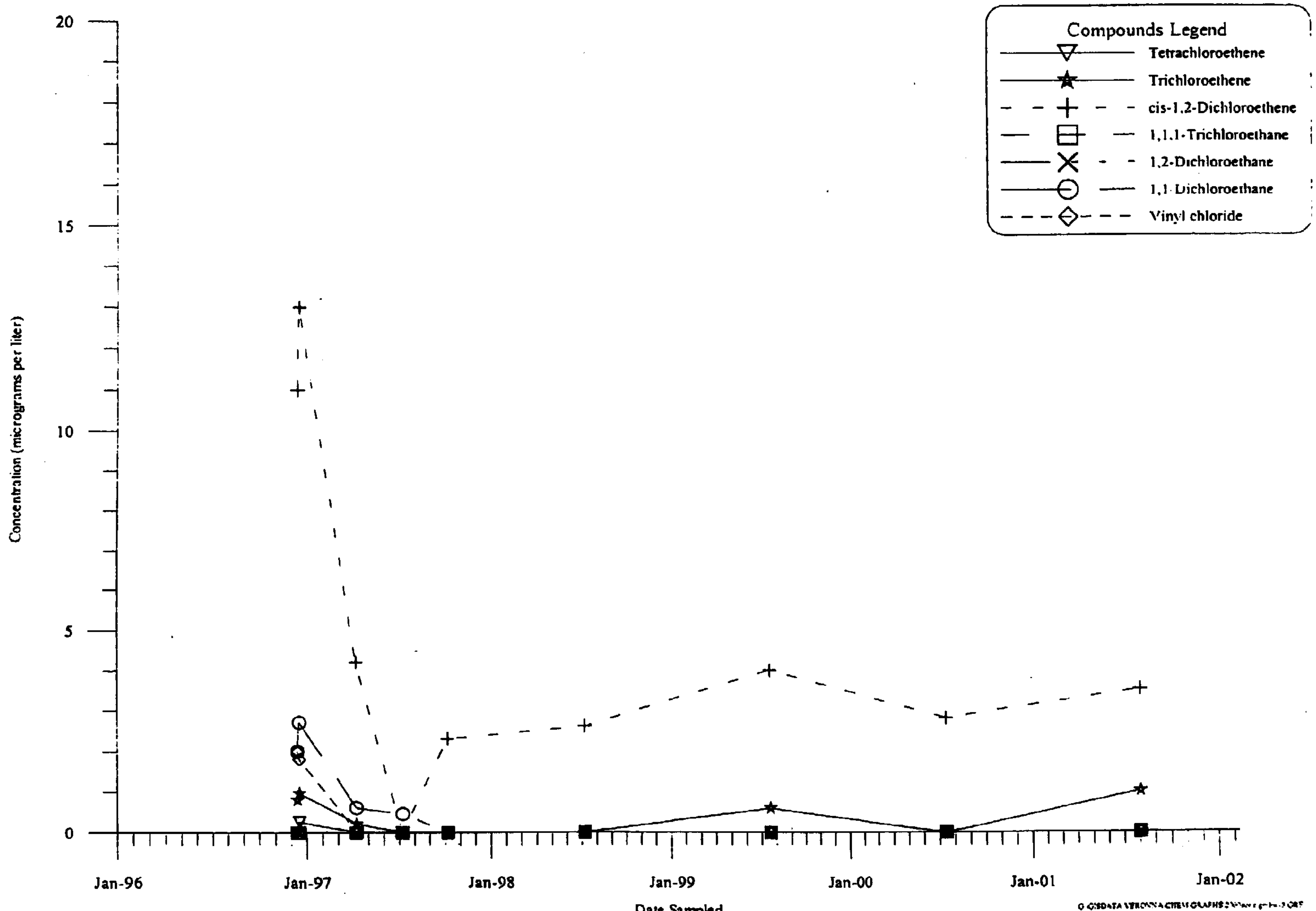
FIGURE 12



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GMBW-2 at the Veronna Well Field Site through August 2001

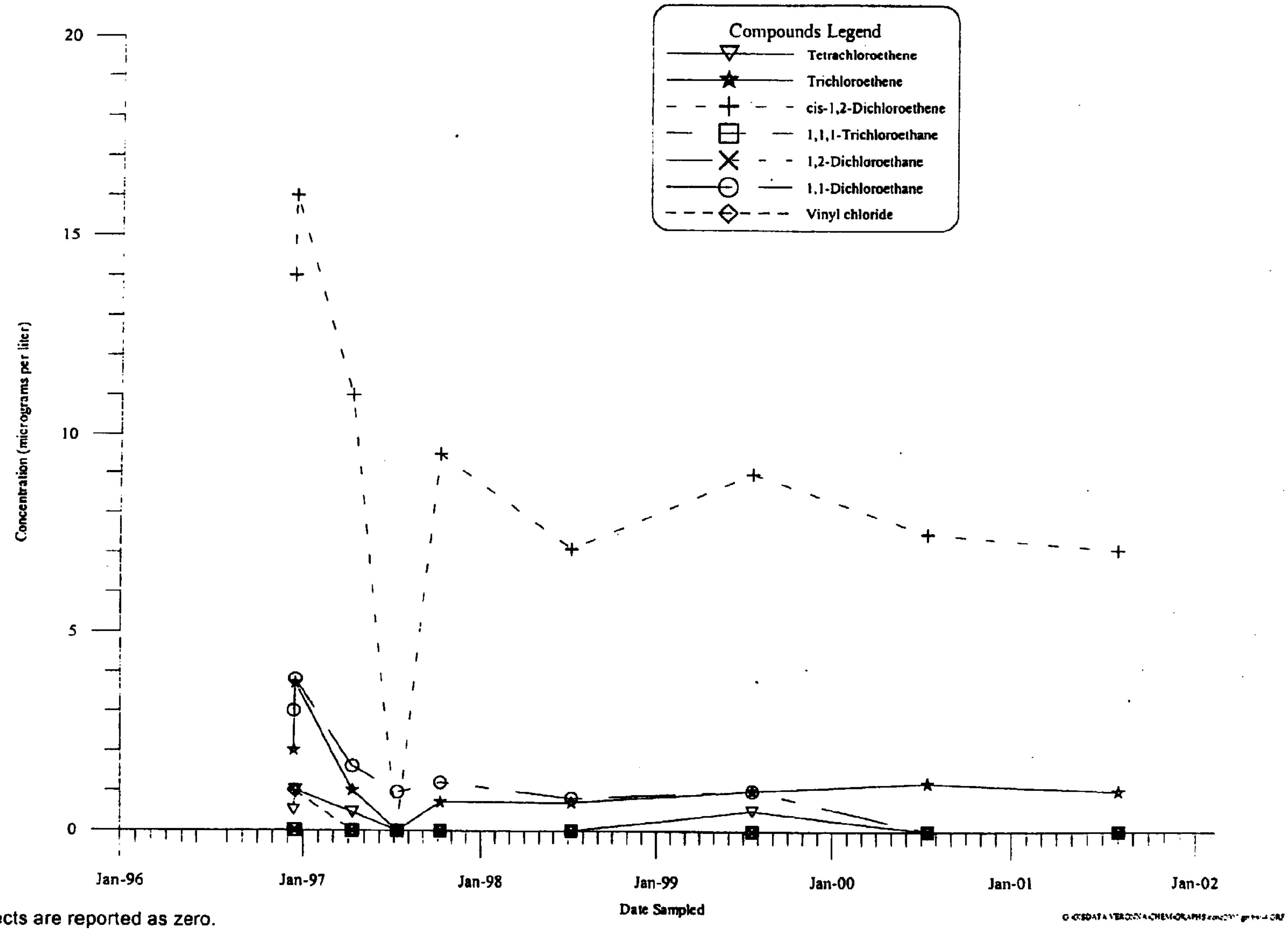
FIGURE 13



Non-detects are reported as zero.

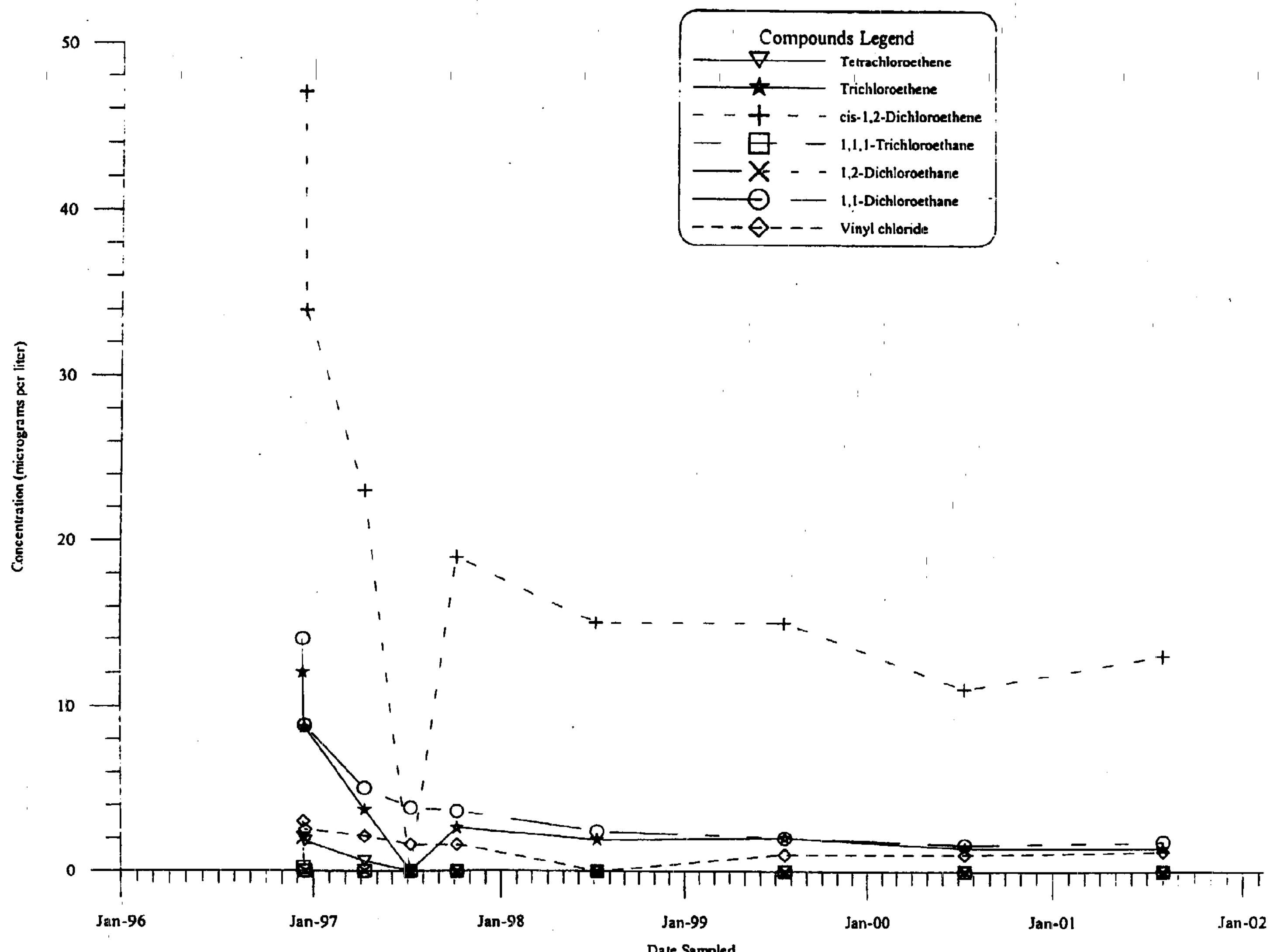
Concentration of Compounds Detected in Well GMBW-3 at the Veronna Well Field Site through August 2001

FIGURE 14



Non-detects are reported as zero.

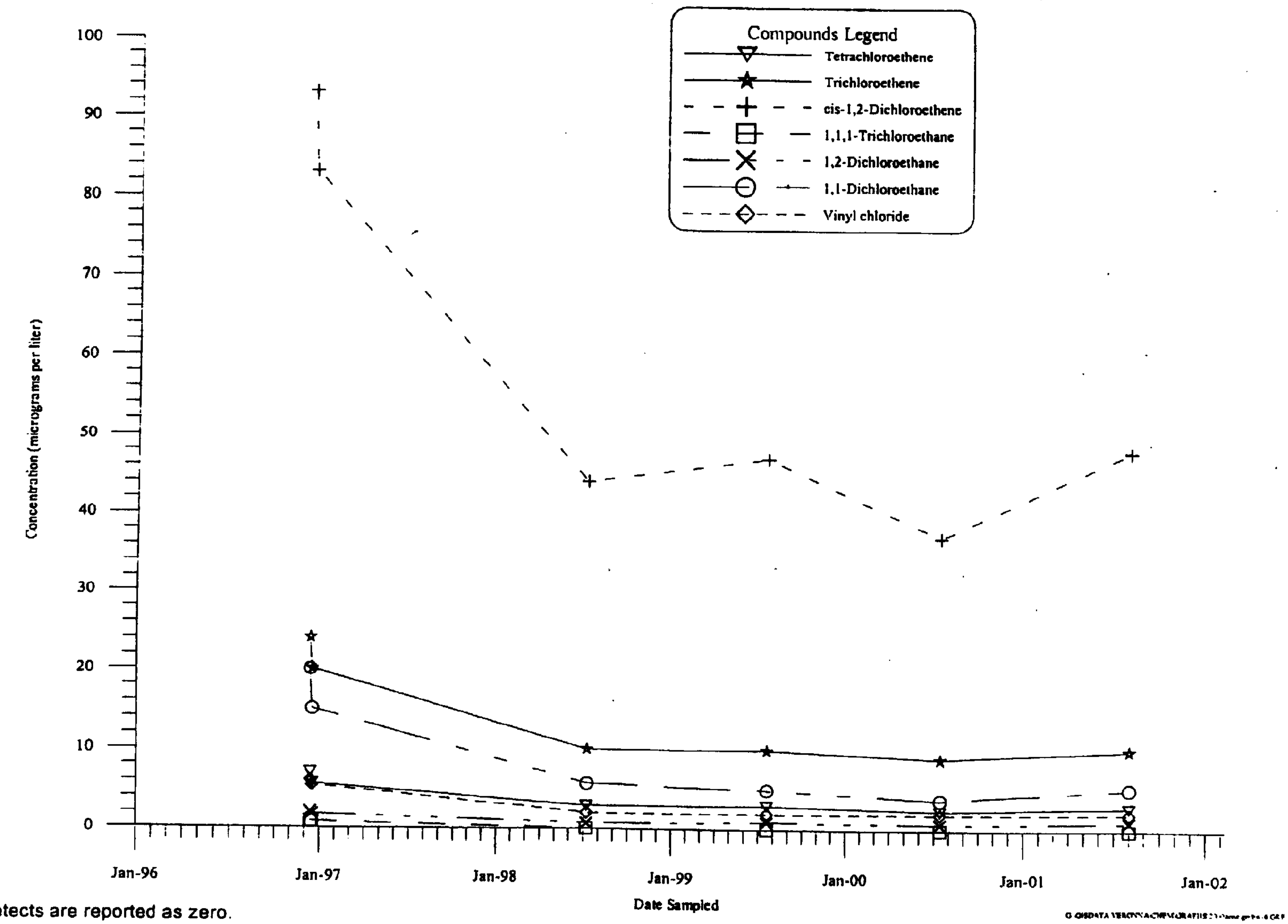
Concentration of Compounds Detected in Well GMBW-4 at the Veronna Well Field Site through August 2001	FIGURE 15



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GMBW-5 at the Veronna Well Field Site through August 2001

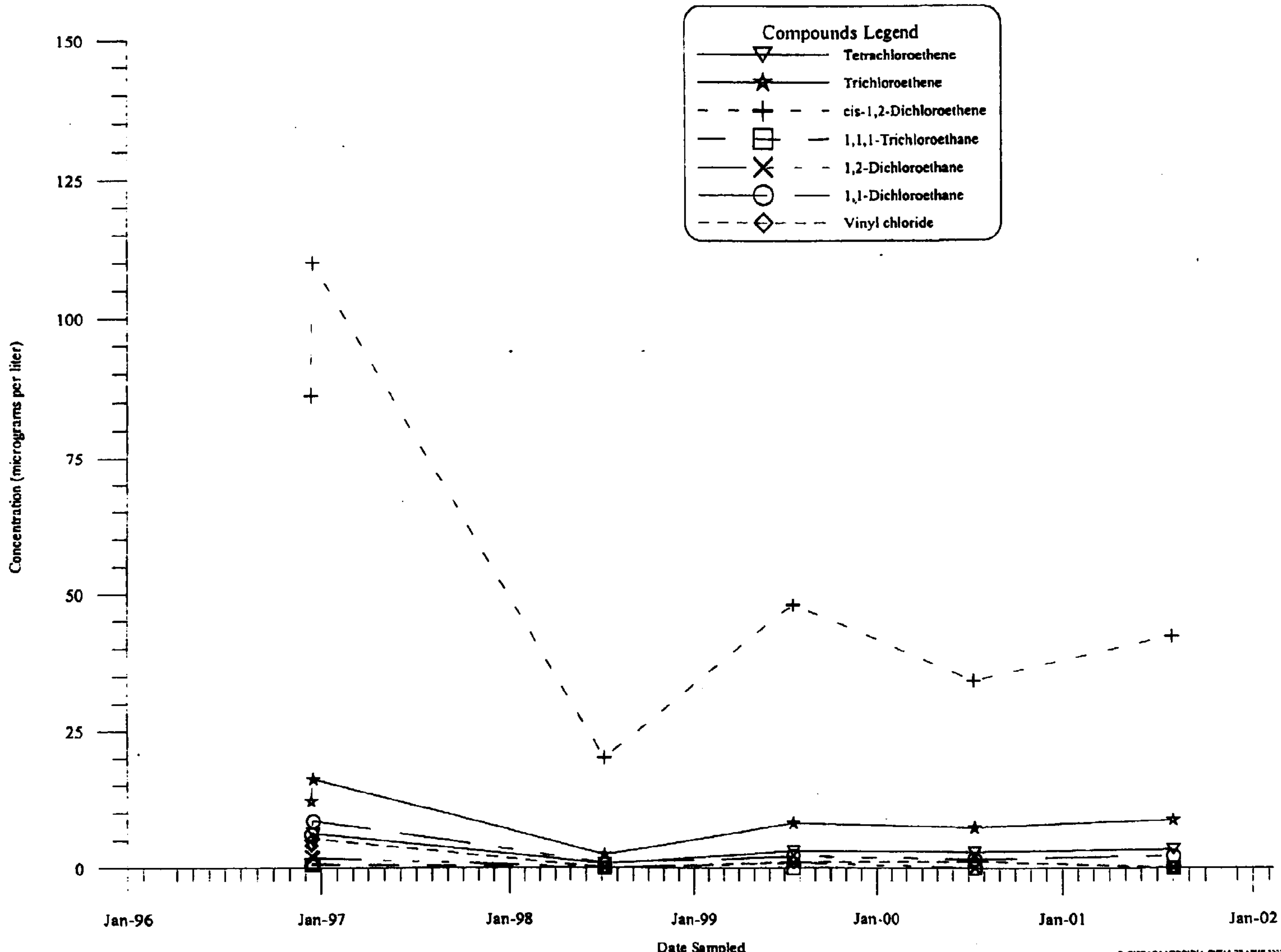
FIGURE 16



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GMBW-6 at the Veronna Well Field Site through August 2001

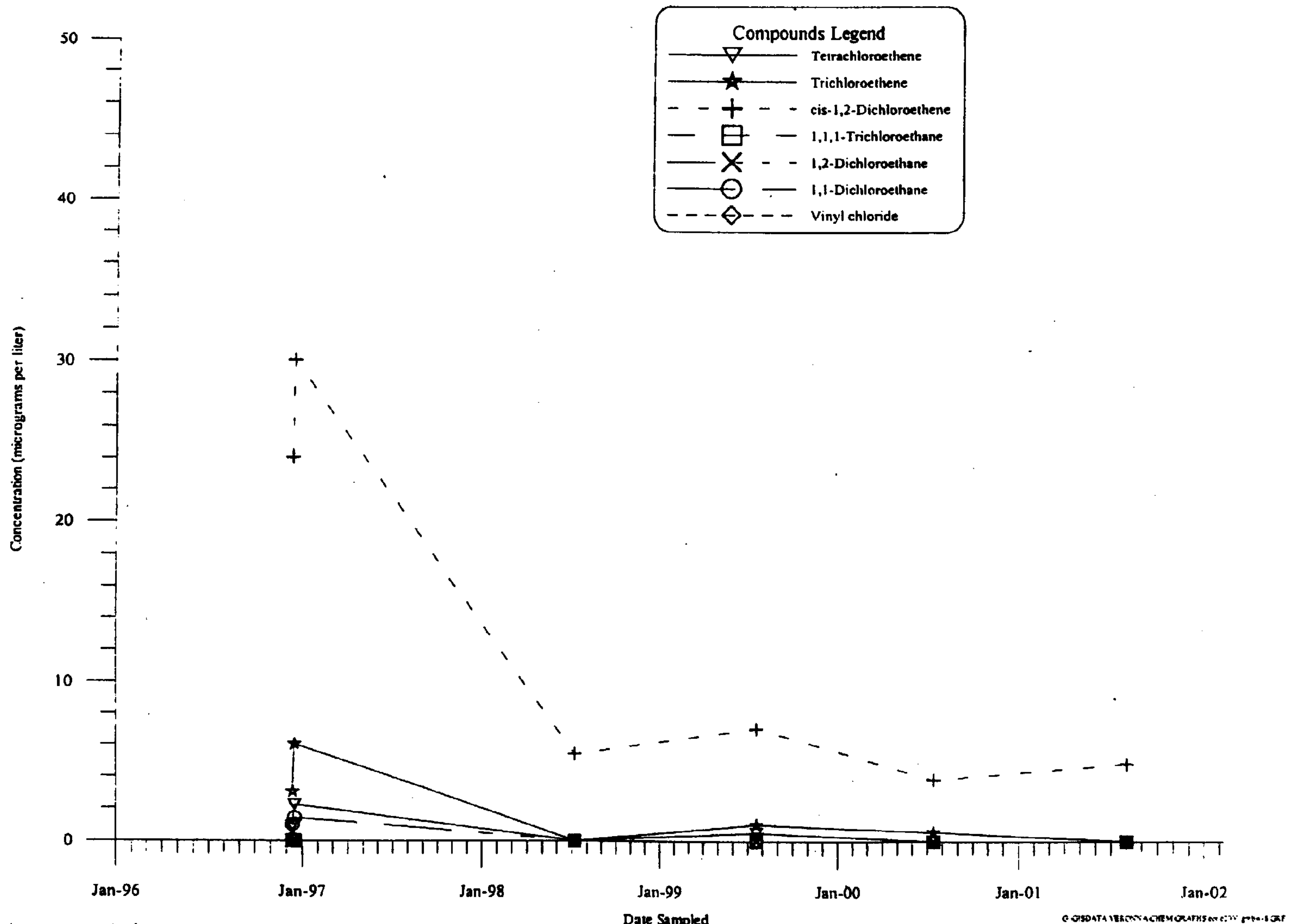
FIGURE 17



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GMBW-7 at the Veronna Well Field Site through August 2001

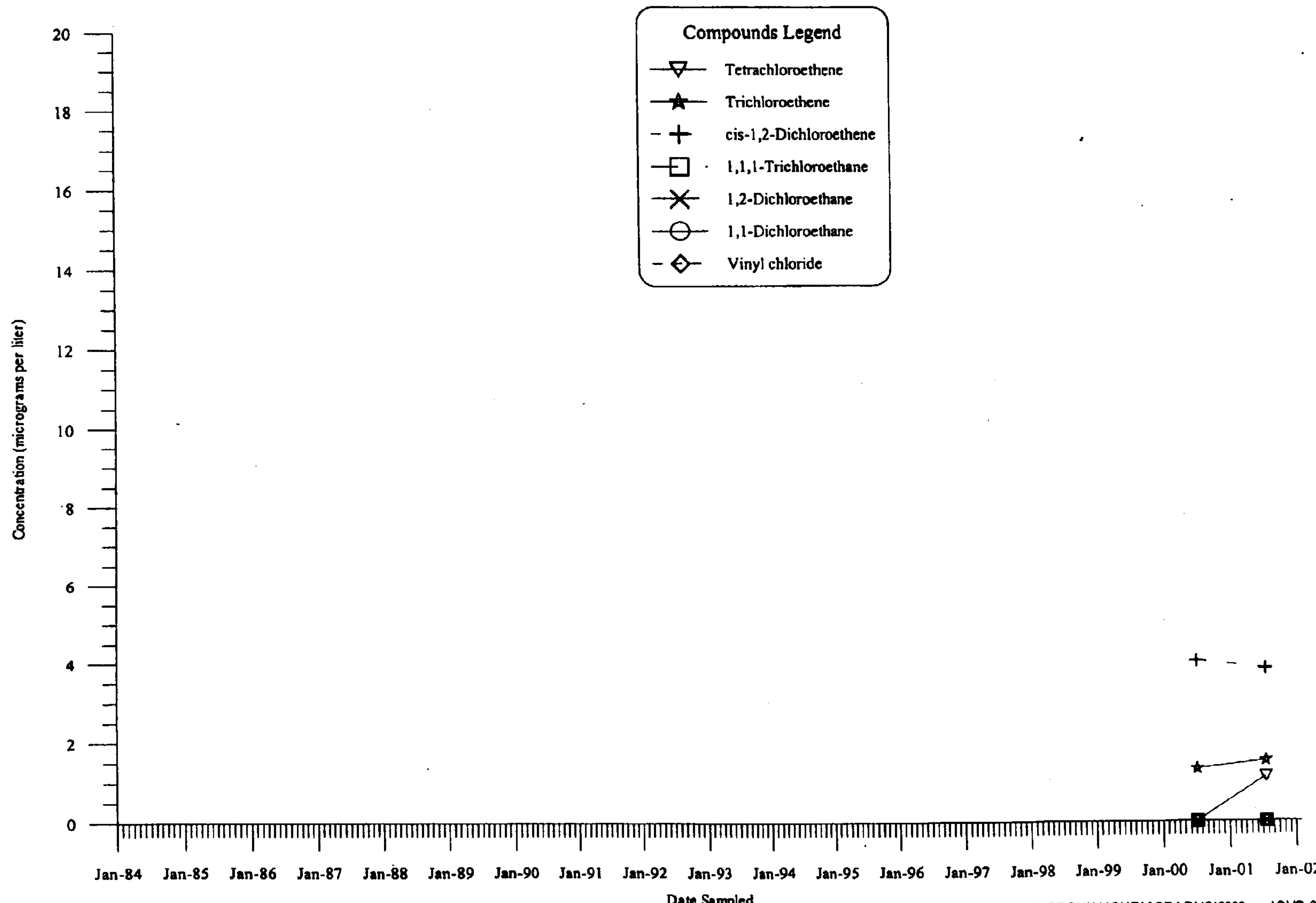
FIGURE 18



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GMBW-8 at the Veronna Well Field Site through August 2001

FIGURE 19

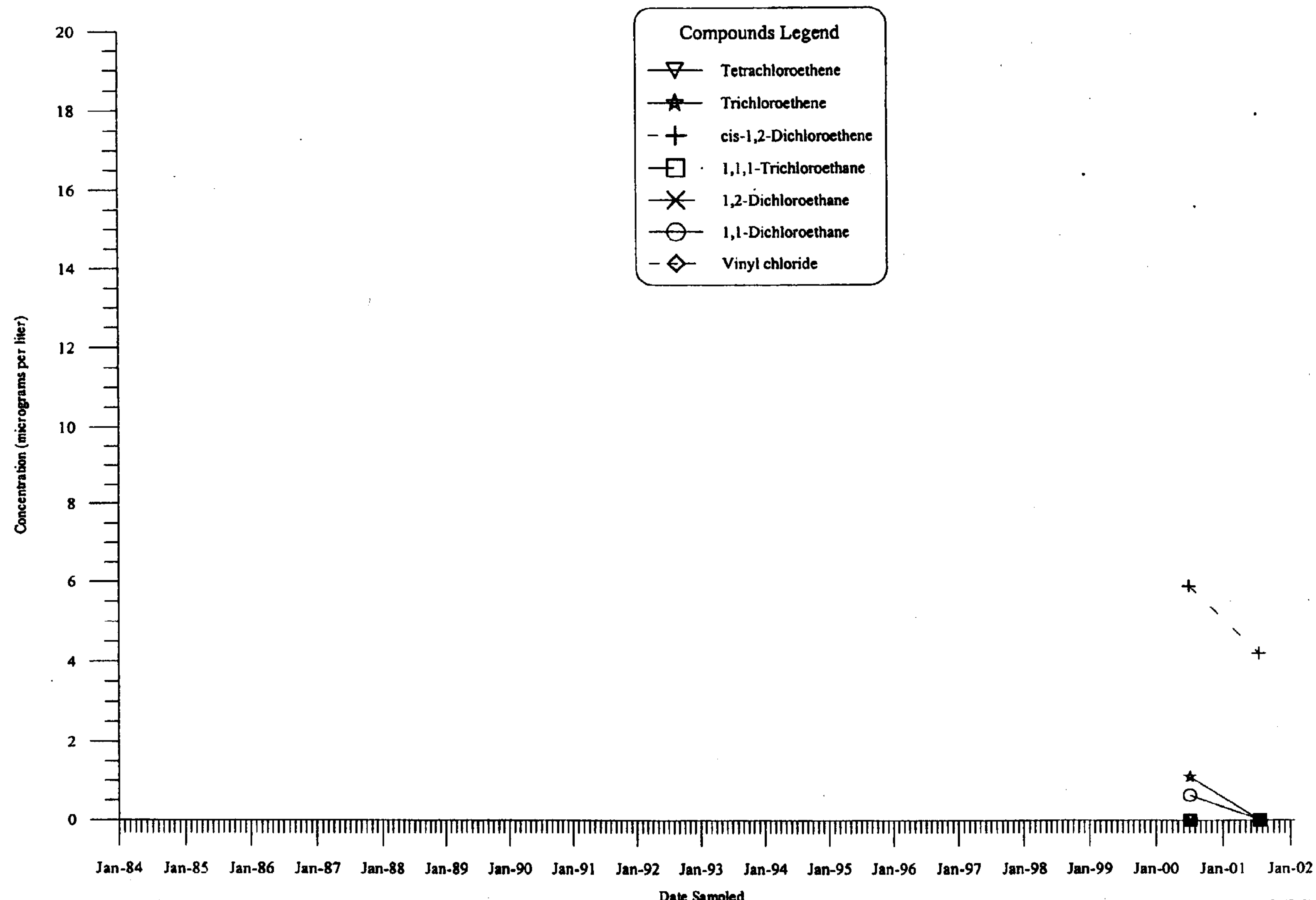


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEMGRAPHS\2000conc\GMP-2I.GRF

Concentration of Compounds Detected in Well GMP-2I at the Veronna Well Field Site through August 2001

FIGURE 20

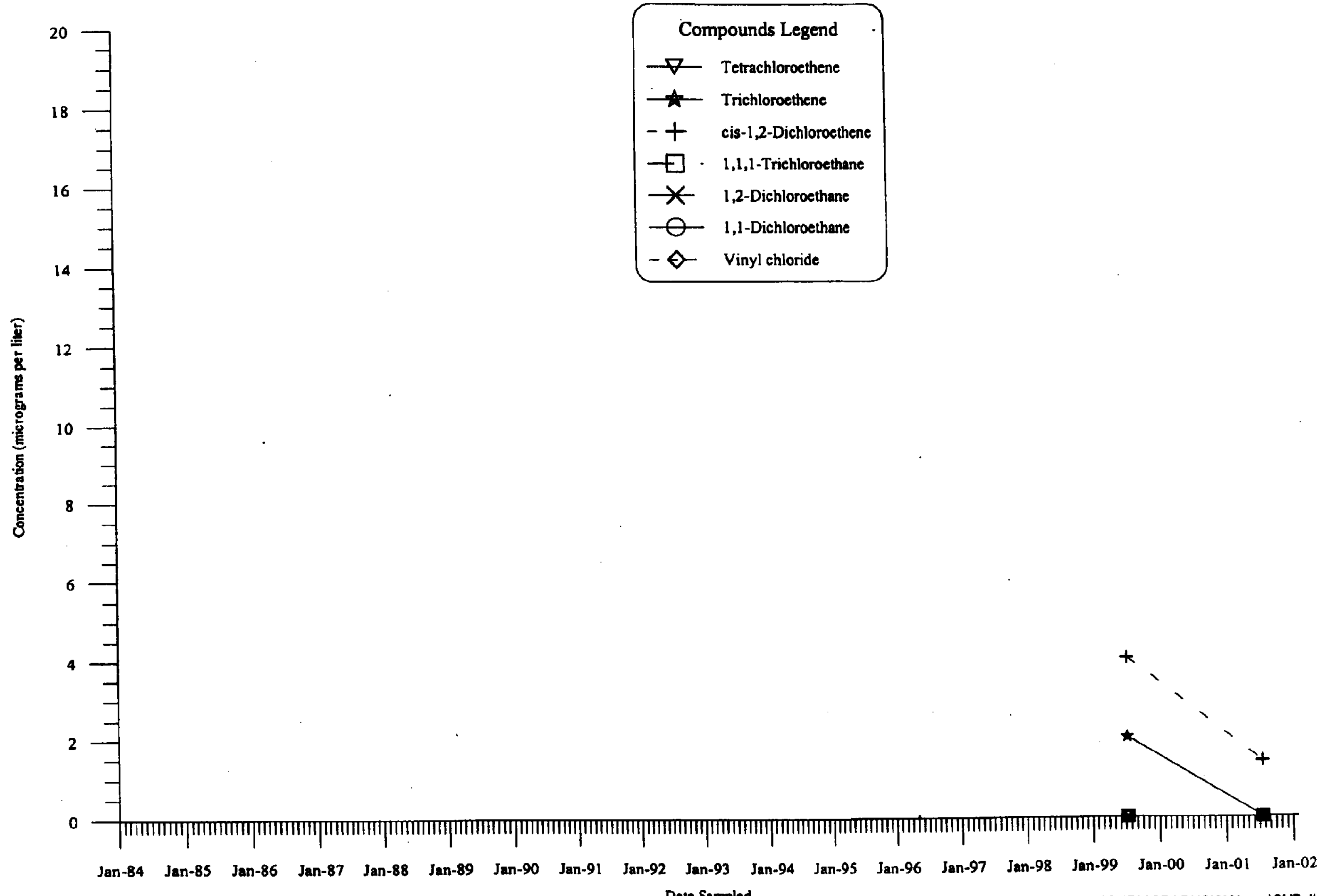


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEM\GRAPHS\2000conc\GMP-3I.GRF

Concentration of Compounds Detected in Well GMP-3I at the Veronna Well Field Site through August 2001

FIGURE 21

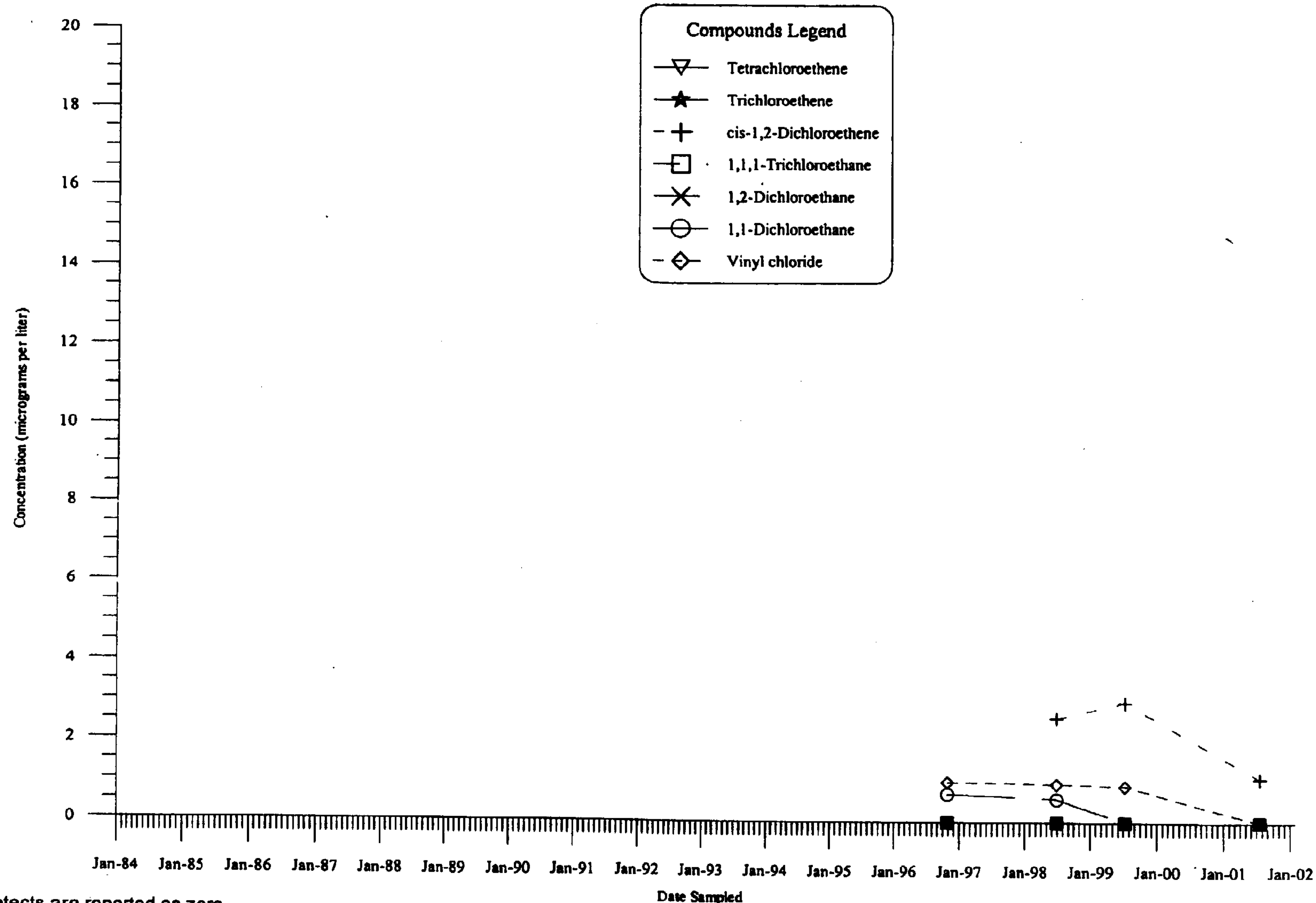


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEMGRAPHS\2000conc\GMP-4I.GRF

Concentration of Compounds Detected in Well GMP-4I at the Veronna Well Field Site through August 2001

FIGURE 22

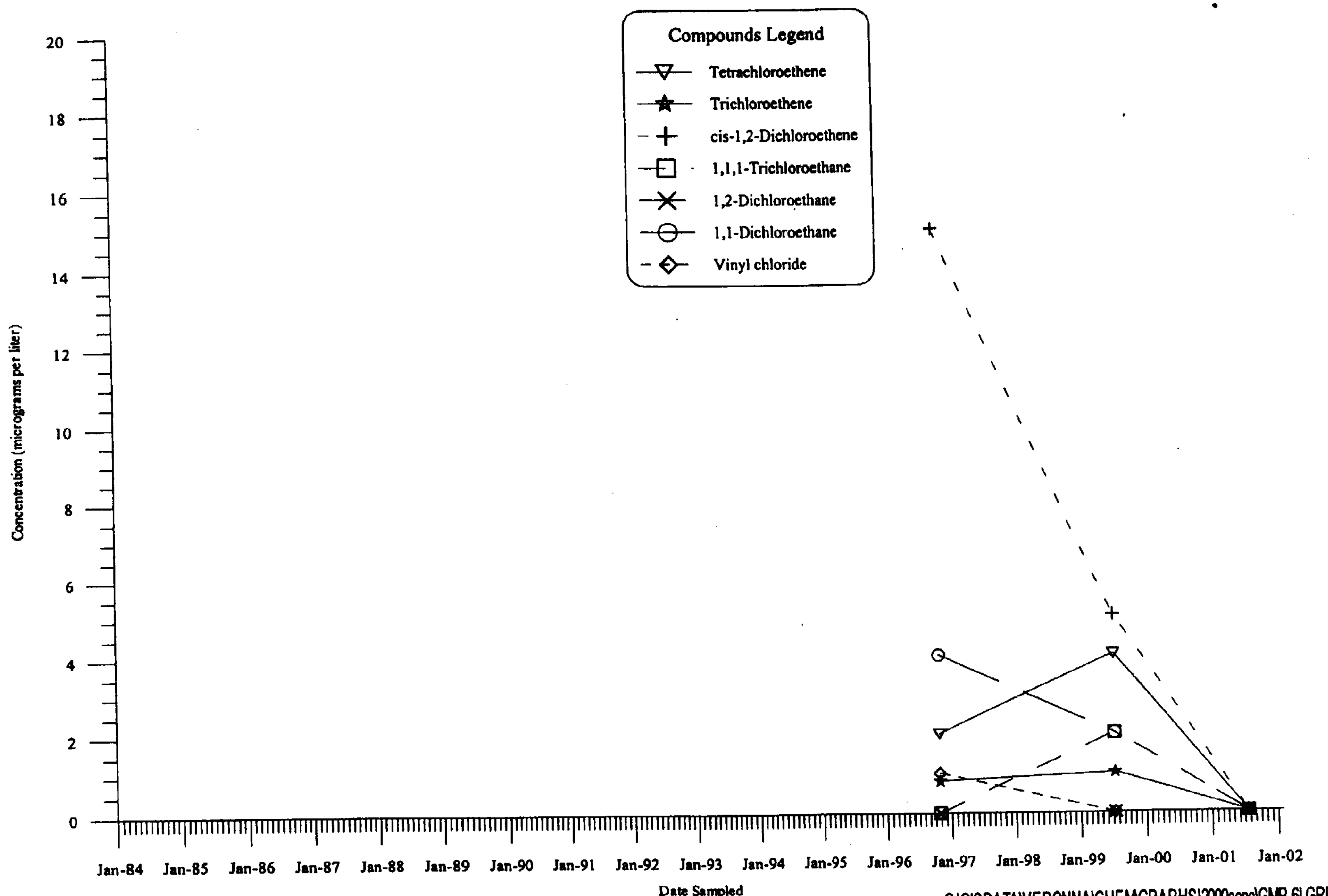


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEM\GRAPHS\2000conc\GMP-5D.GRF

Concentration of Compounds Detected in Well GMP-5D at the Veronna Well Field Site through August 2001

FIGURE 23

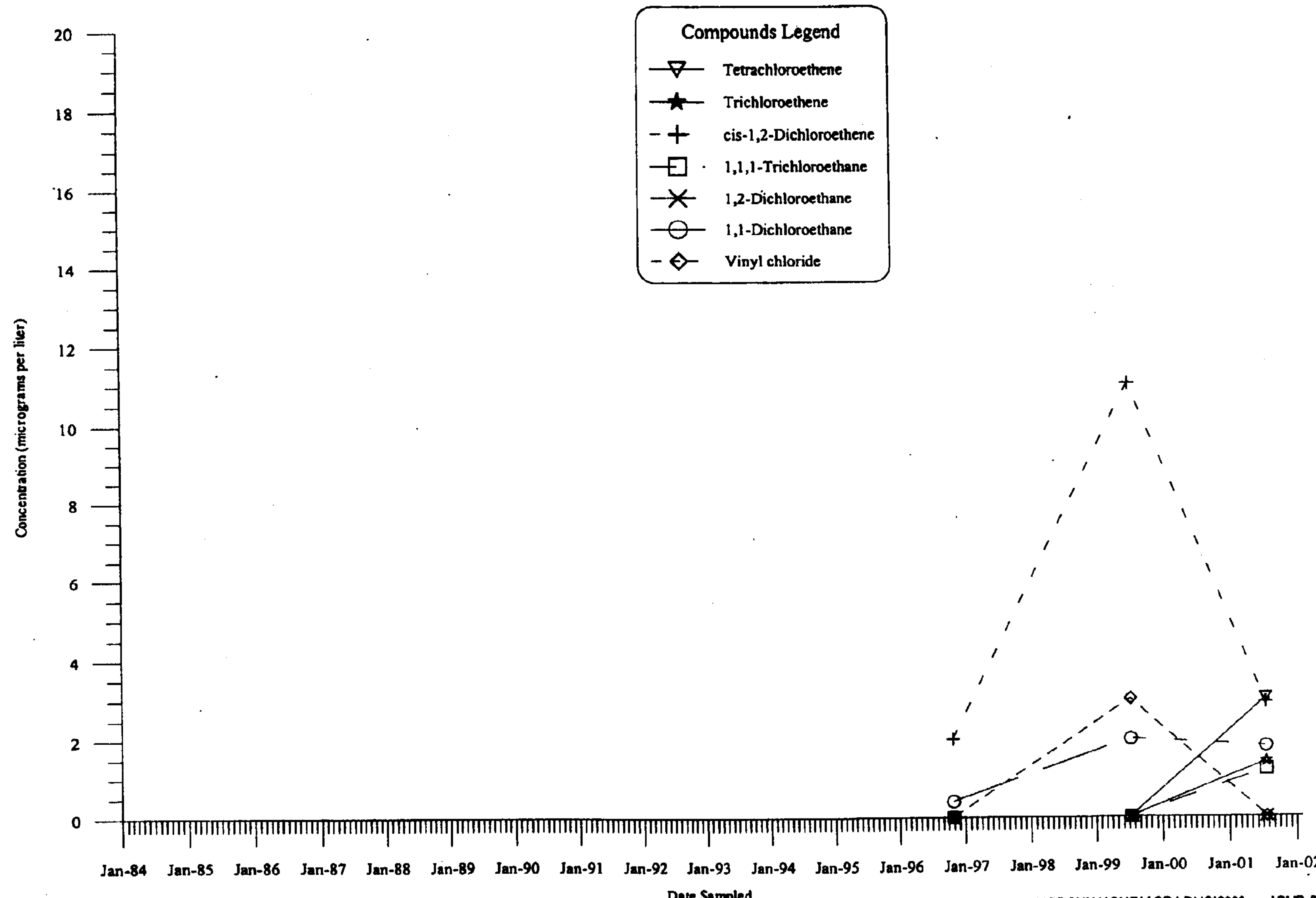


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEM\GRAPHS\2000conc\GMP-6I.GRF

Concentration of Compounds Detected in Well GMP-6I at the Veronna Well Field Site through August 2001

FIGURE 24



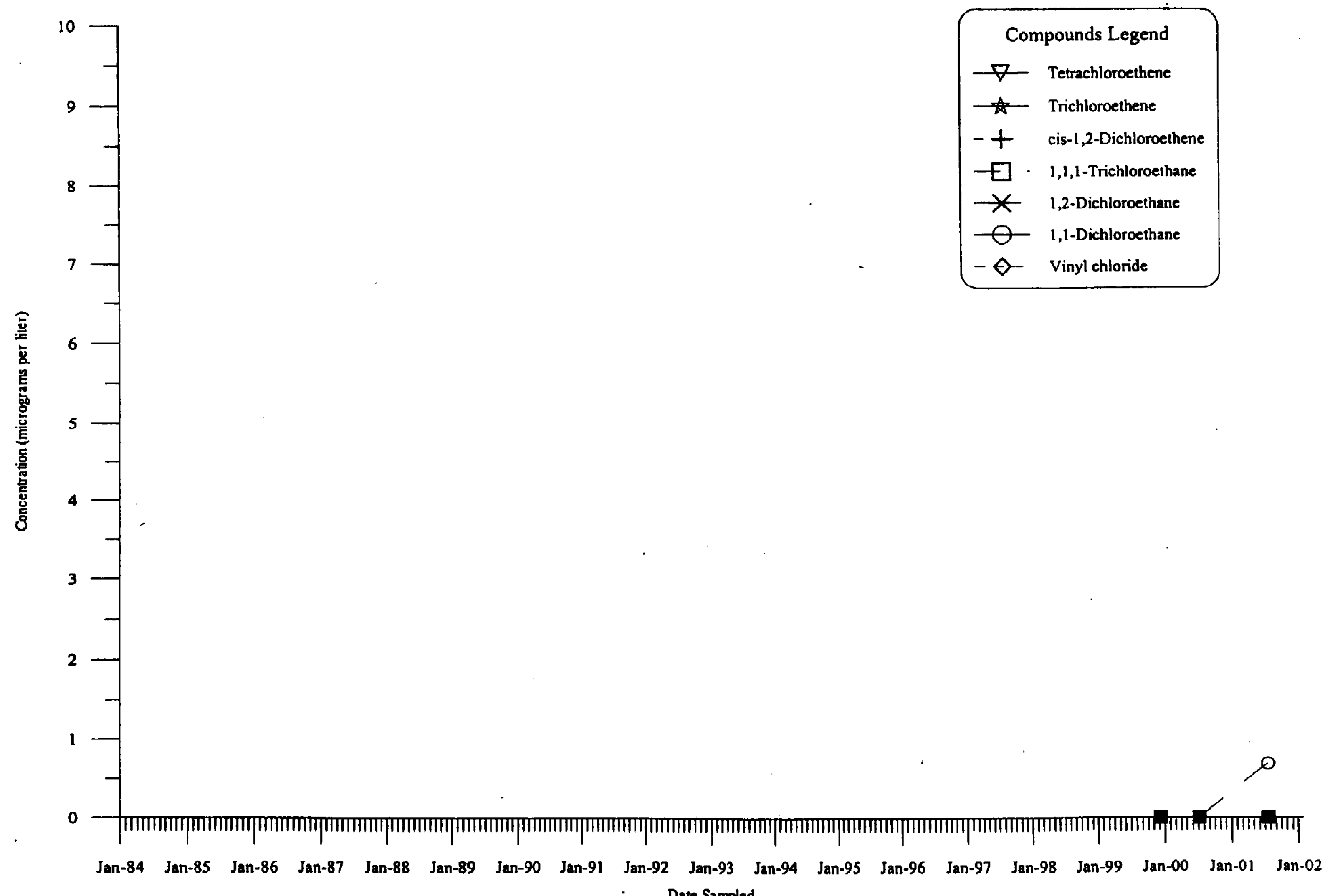
Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEMGRAPHS\2000conc\GMP-6D.GRF

Concentration of Compounds Detected in Well GMP-6D at the Veronna Well Field Site through August 2001

FIGURE

25

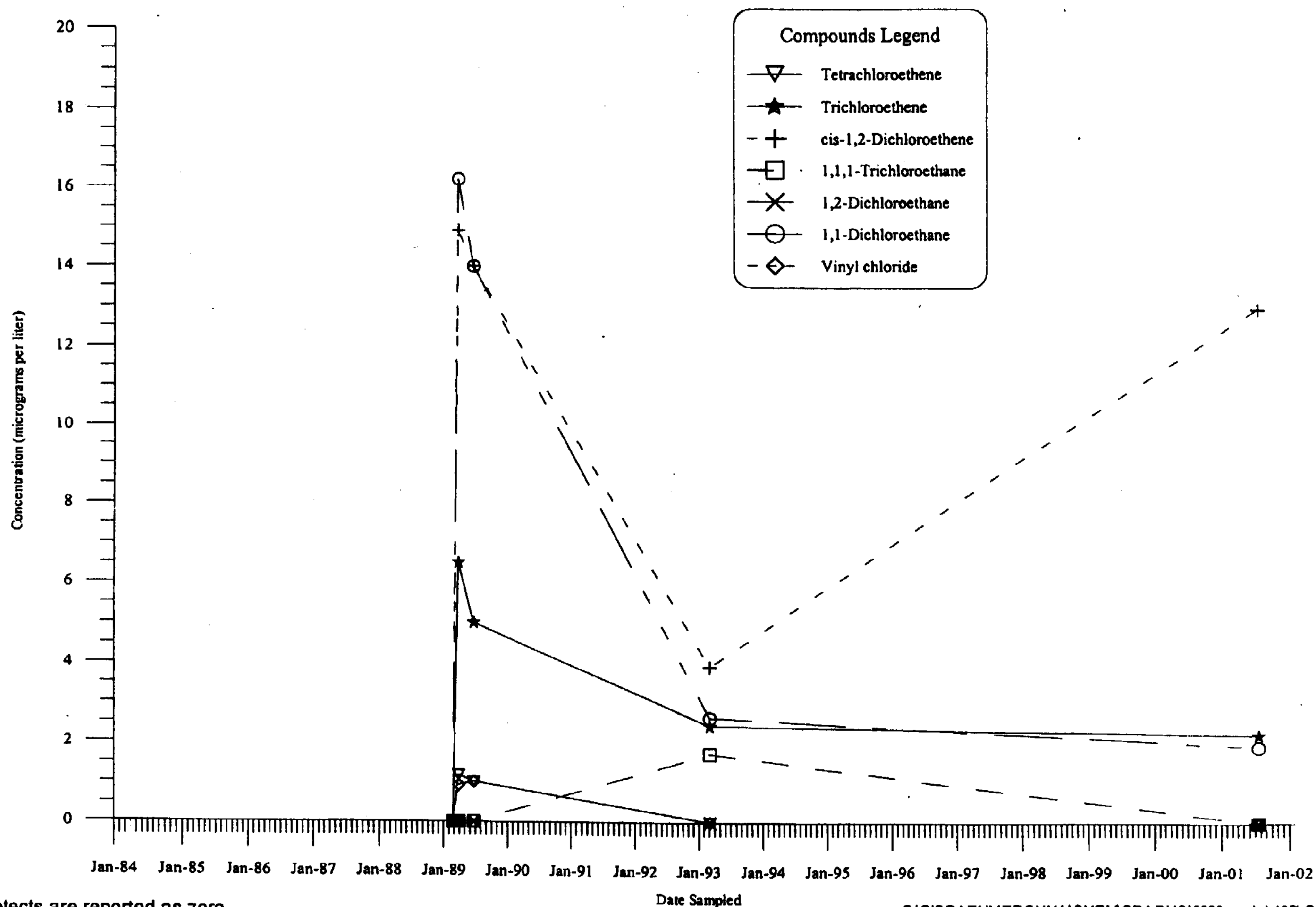


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEMGRAPHS\2000conc\DEQ1A.GRF

Concentration of Compounds Detected in Well DEQ-1A at the Veronna Well Field Site through August 2001

FIGURE
29

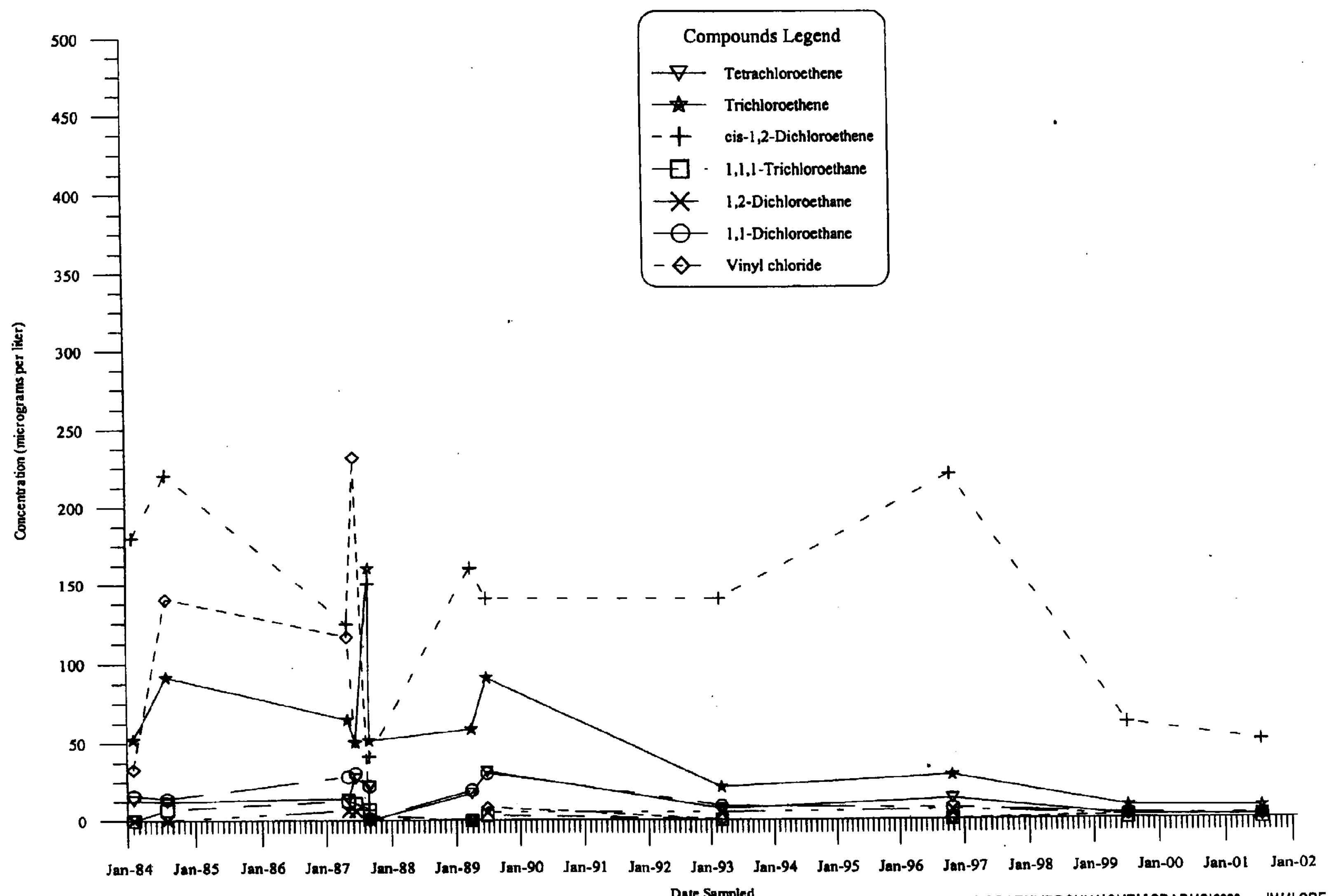


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEMGRAPHS\2000conc\ch105i.GRF

Concentration of Compounds Detected in Well CH-105I at the Veronna Well Field Site through August 2001

FIGURE
26

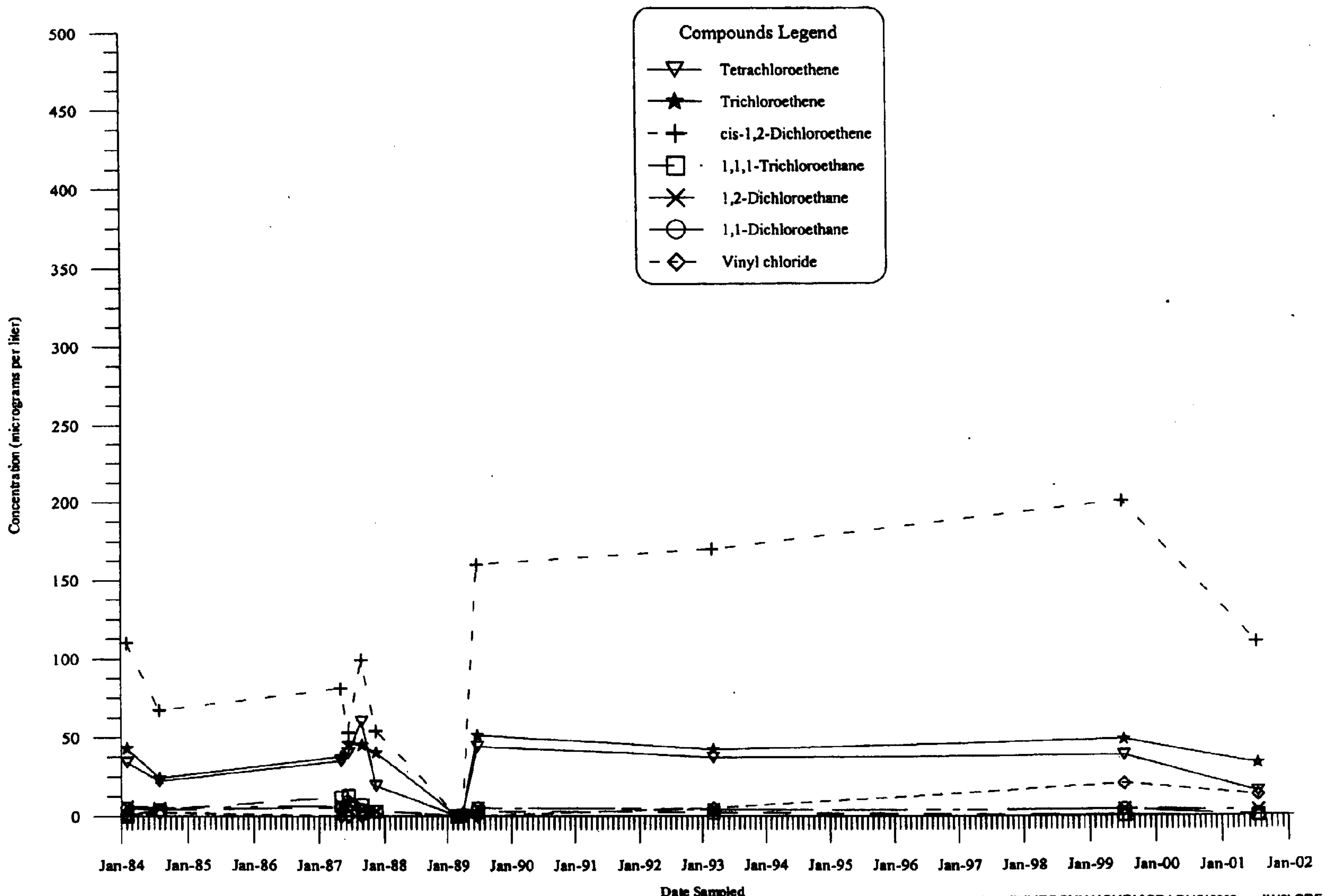


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEM\GRAPHS\2000conc\W4I.GRF

Concentration of Compounds Detected in Well W-4I at the Veronna Well Field Site through August 2001

FIGURE 27

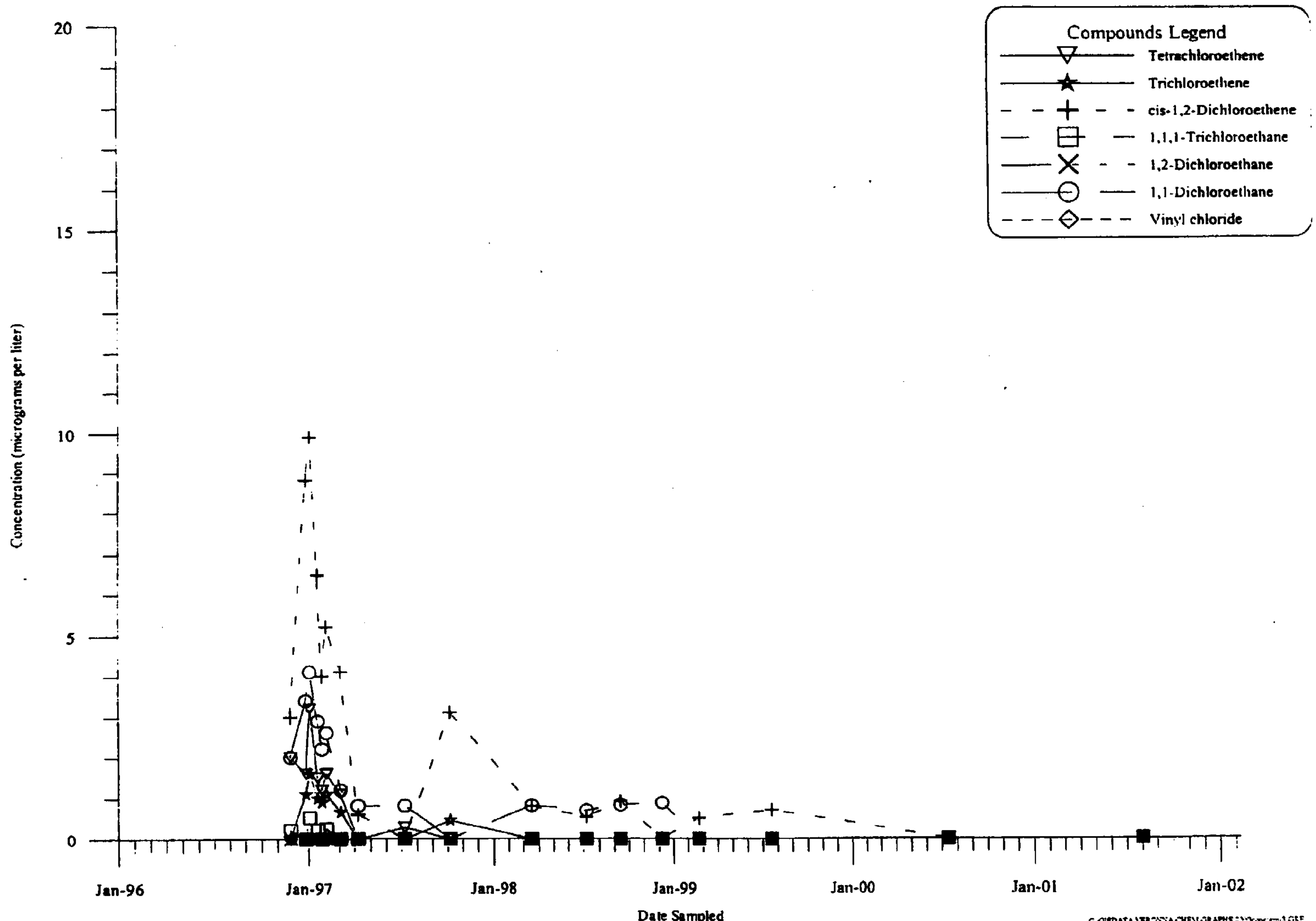


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEMGRAPHS\2000conc\W8I.GRF

Concentration of Compounds Detected in Well W-8I at the Veronna Well Field Site through August 2001

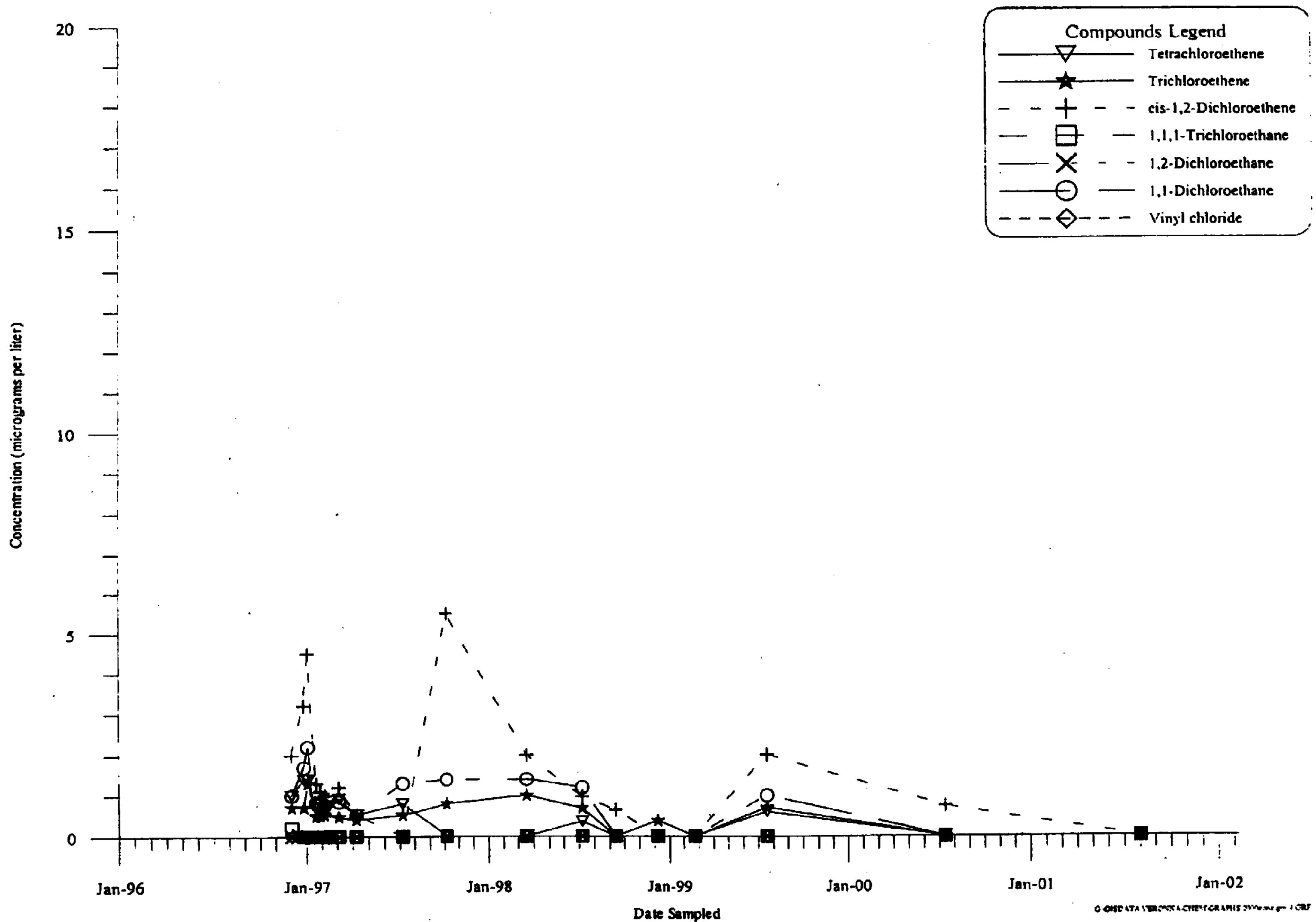
FIGURE 28



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GM-3 at the Veronna Well Field Site through August 2001

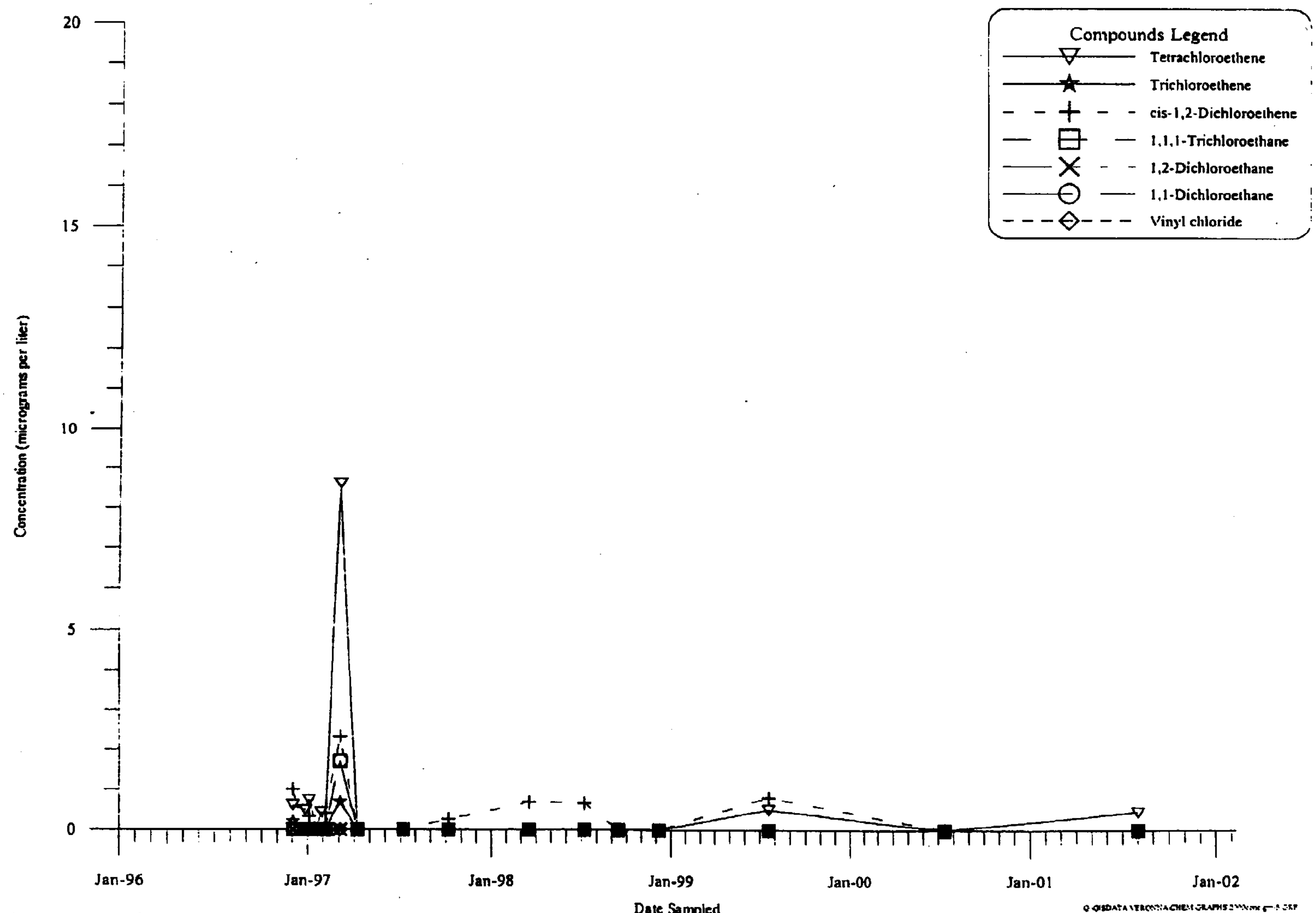
FIGURE 30



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GM-4 at the Veronna Well Field Site through August 2001

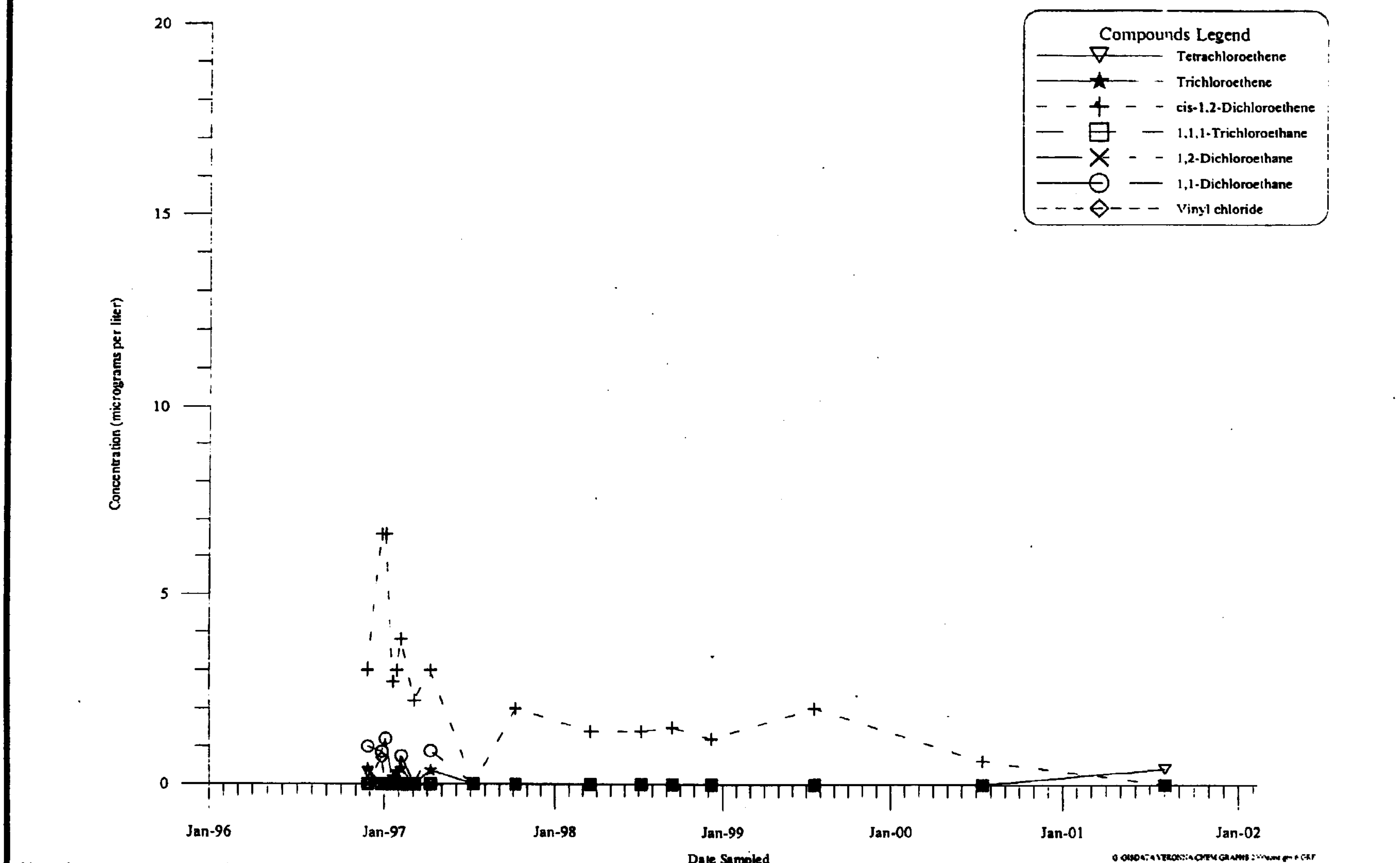
FIGURE 31



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GM-5 at the Veronna Well Field Site through August 2001

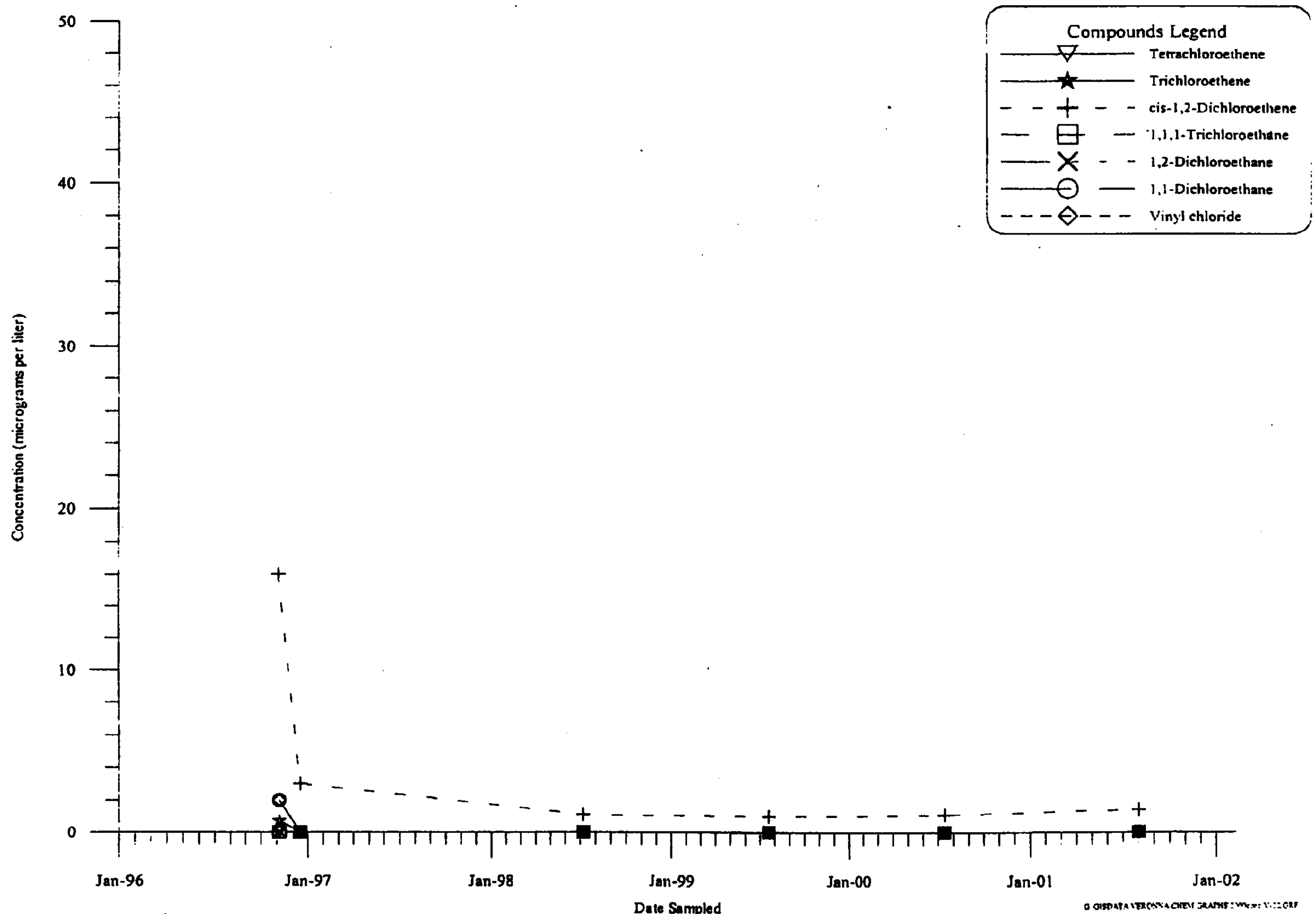
FIGURE 32



Non-detects are reported as zero.

Concentration of Compounds Detected in Well GM-6 at the Veronna Well Field Site through August 2001

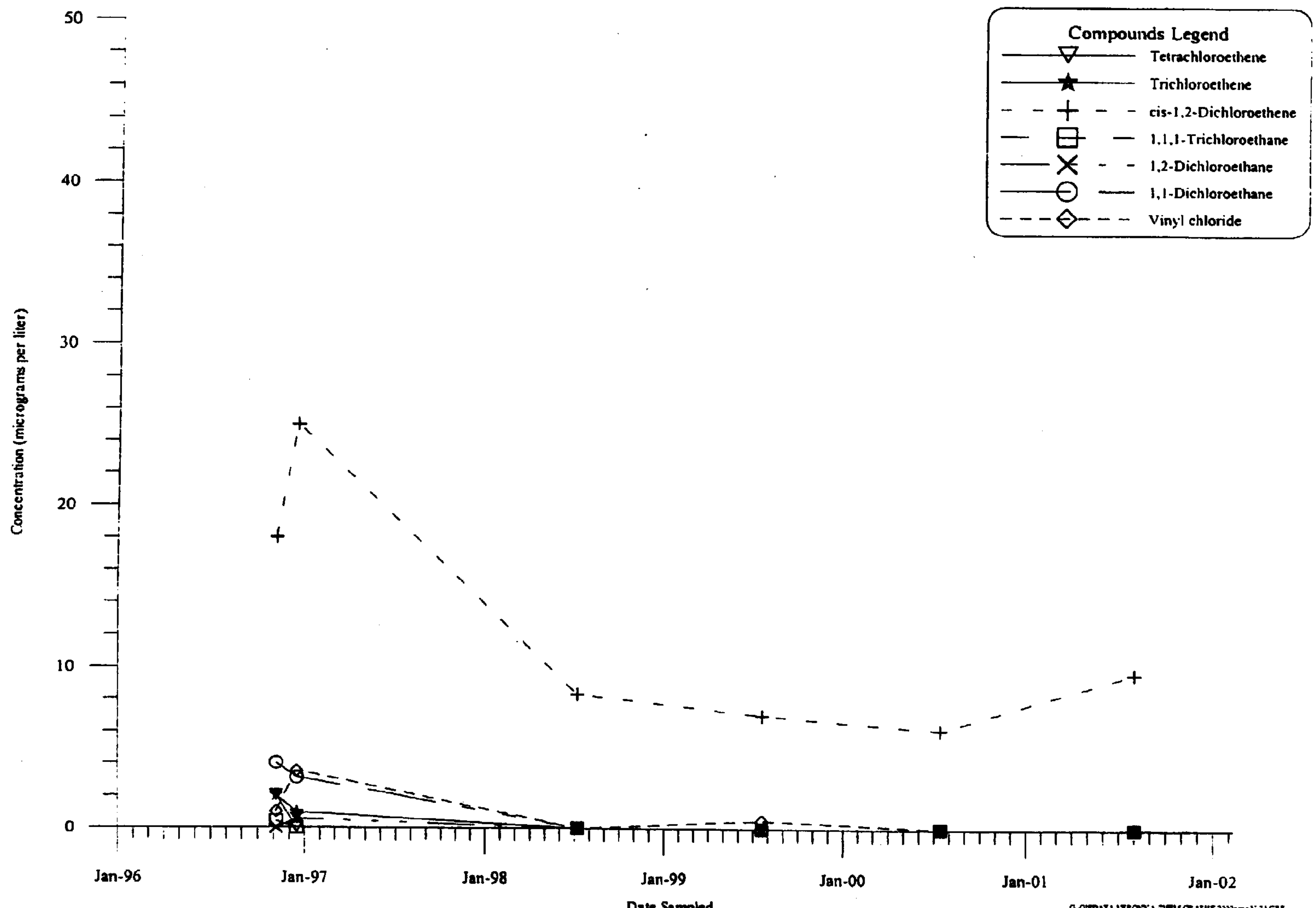
FIGURE 33



Non-detects are reported as zero.

Concentration of Compounds Detected in Well V-22 at the Veronna Well Field Site through August 2001

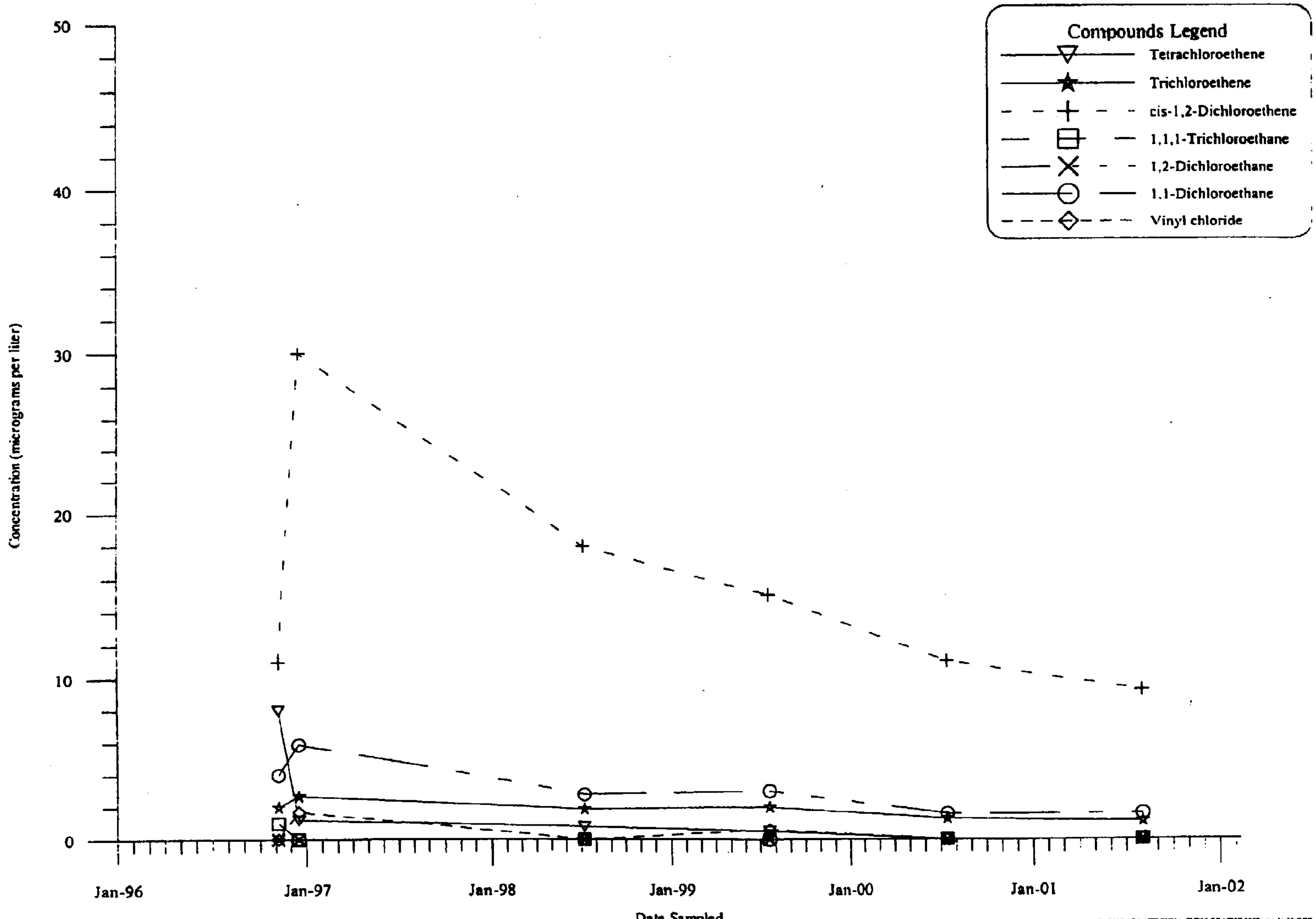
FIGURE 34



Non-detects are reported as zero.

Concentration of Compounds Detected in Well V-24 at the Veronna Well Field Site through August 2001

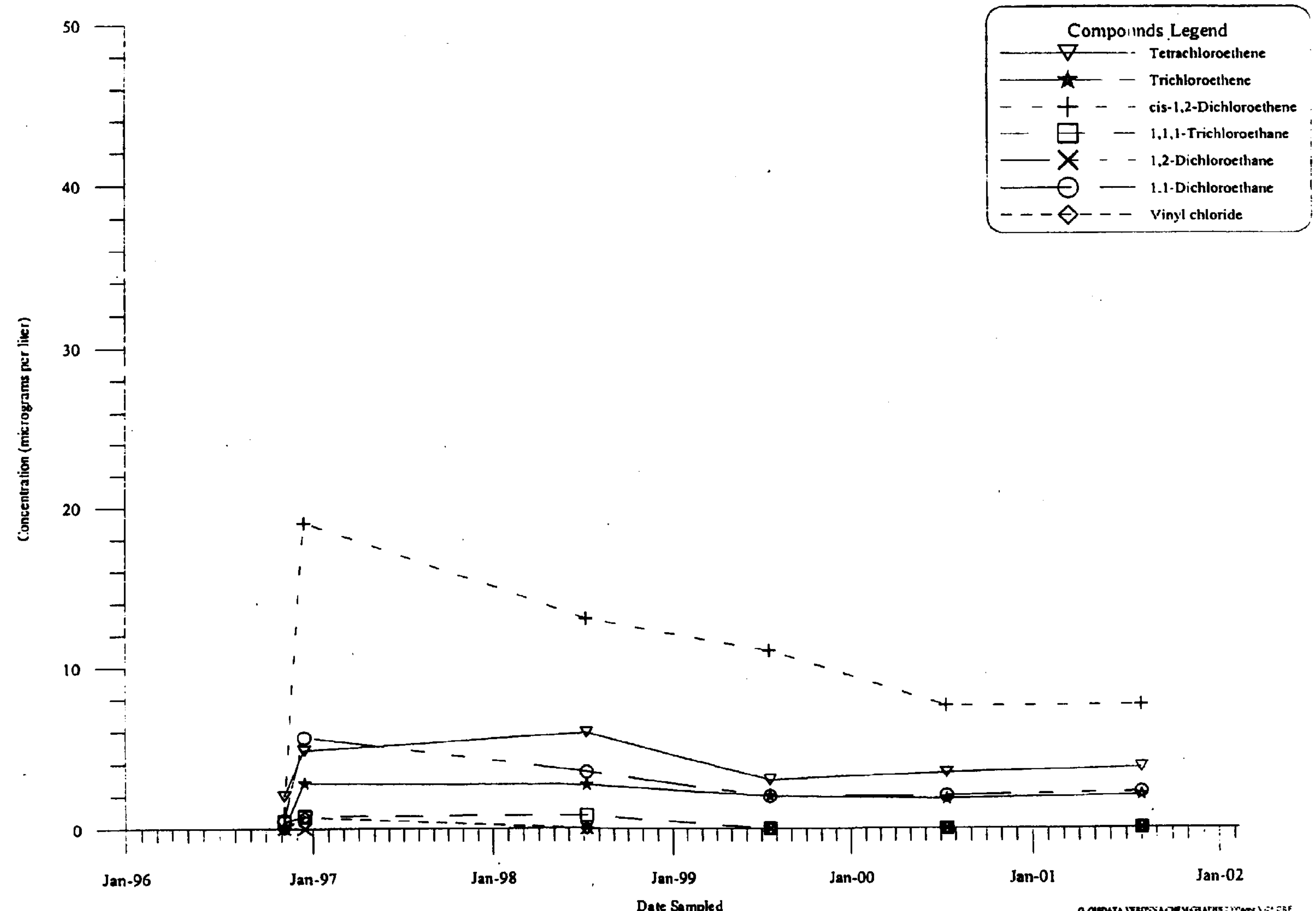
FIGURE 35



Non-detects are reported as zero.

Concentration of Compounds Detected in Well V-25
at the Veronna Well Field Site through August 2001

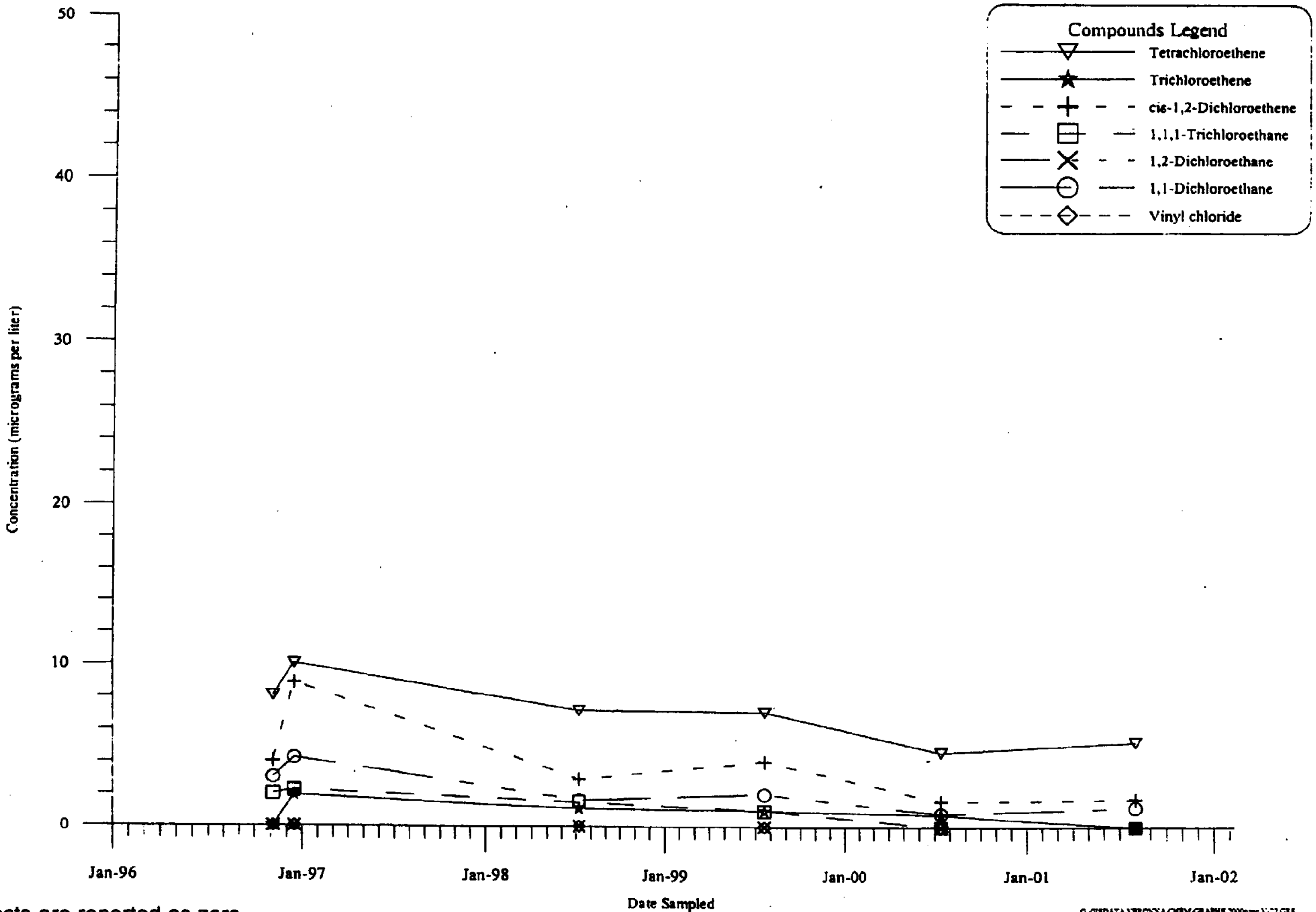
FIGURE 36



Non-detects are reported as zero.

Concentration of Compounds Detected in Well V-26 at the Veronna Well Field Site through August 2001

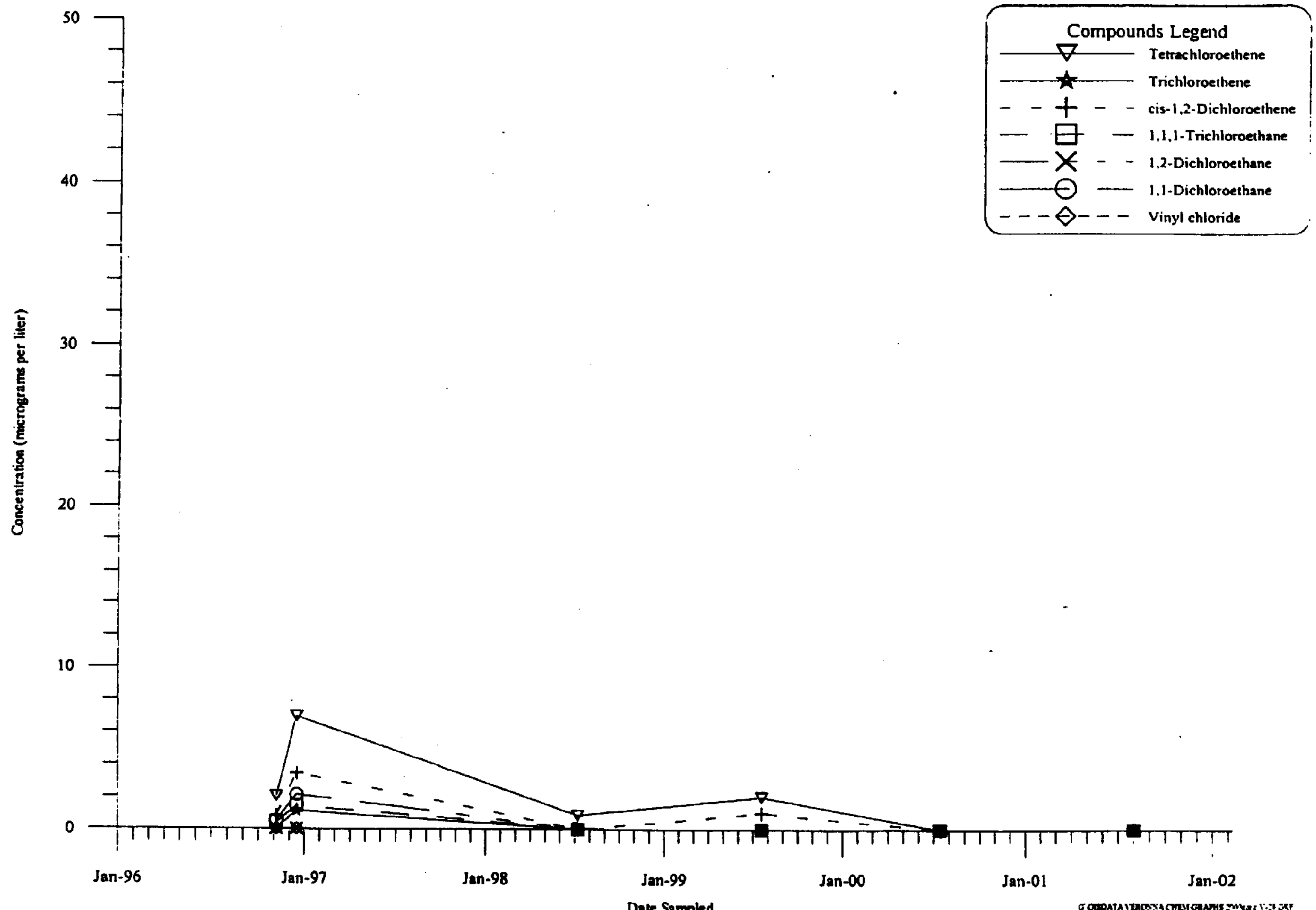
FIGURE 37



Non-detects are reported as zero.

Concentration of Compounds Detected in Well V-27 at the Veronna Well Field Site through August 2001

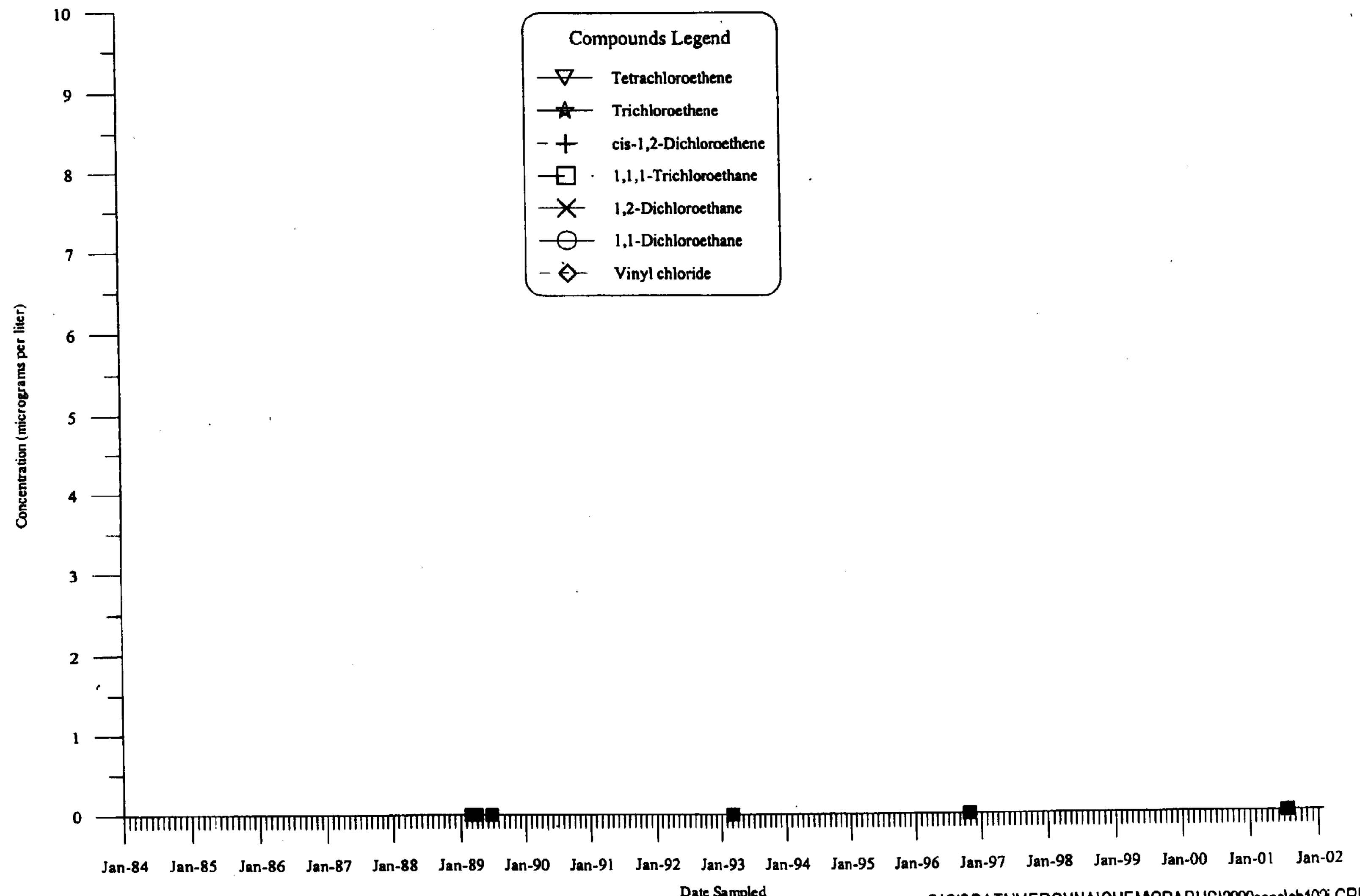
FIGURE 38



Non-detects are reported as zero.

Concentration of Compounds Detected in Well V-28 at the Veronna Well Field Site through August 2001

FIGURE 39

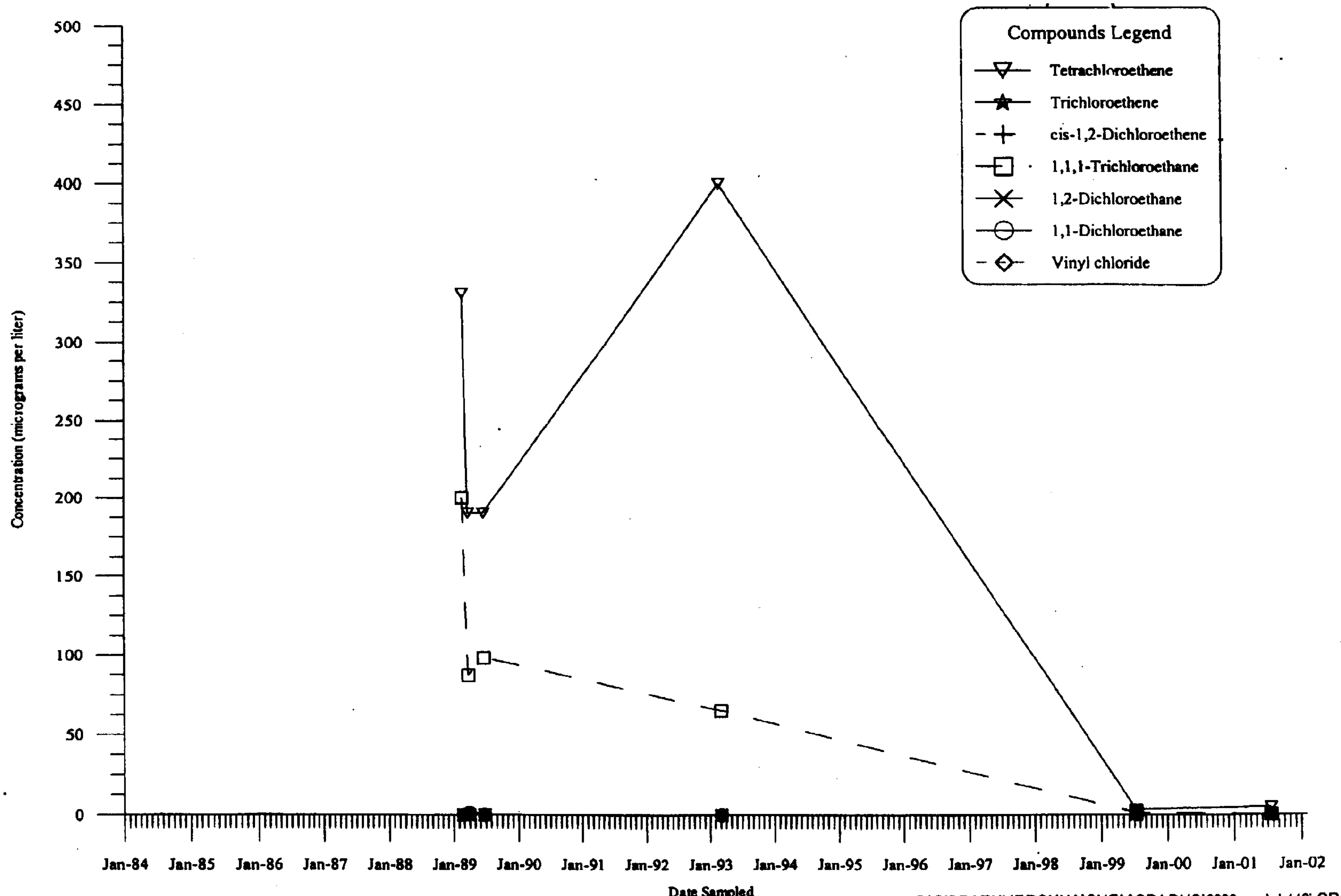


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEMGRAPHS\2000conc\ch102i.GRF

Concentration of Compounds Detected in Well CH-102I at the Veronna Well Field Site through August 2001

FIGURE 40

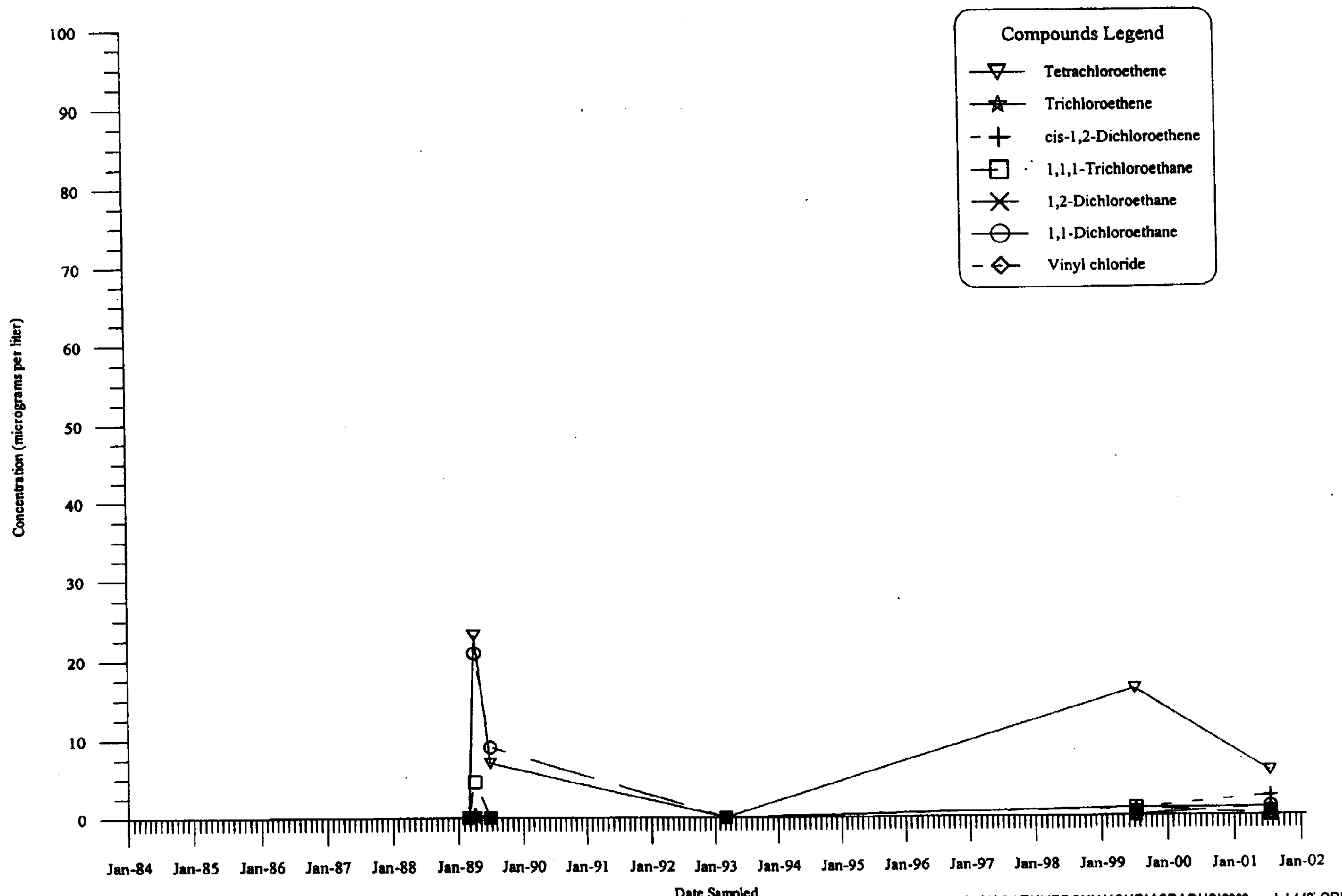


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEM\GRAPHS\2000conc\ch140i.GRF

Concentration of Compounds Detected in Well CH-140I at the Veronna Well Field Site through August 2001

FIGURE 41

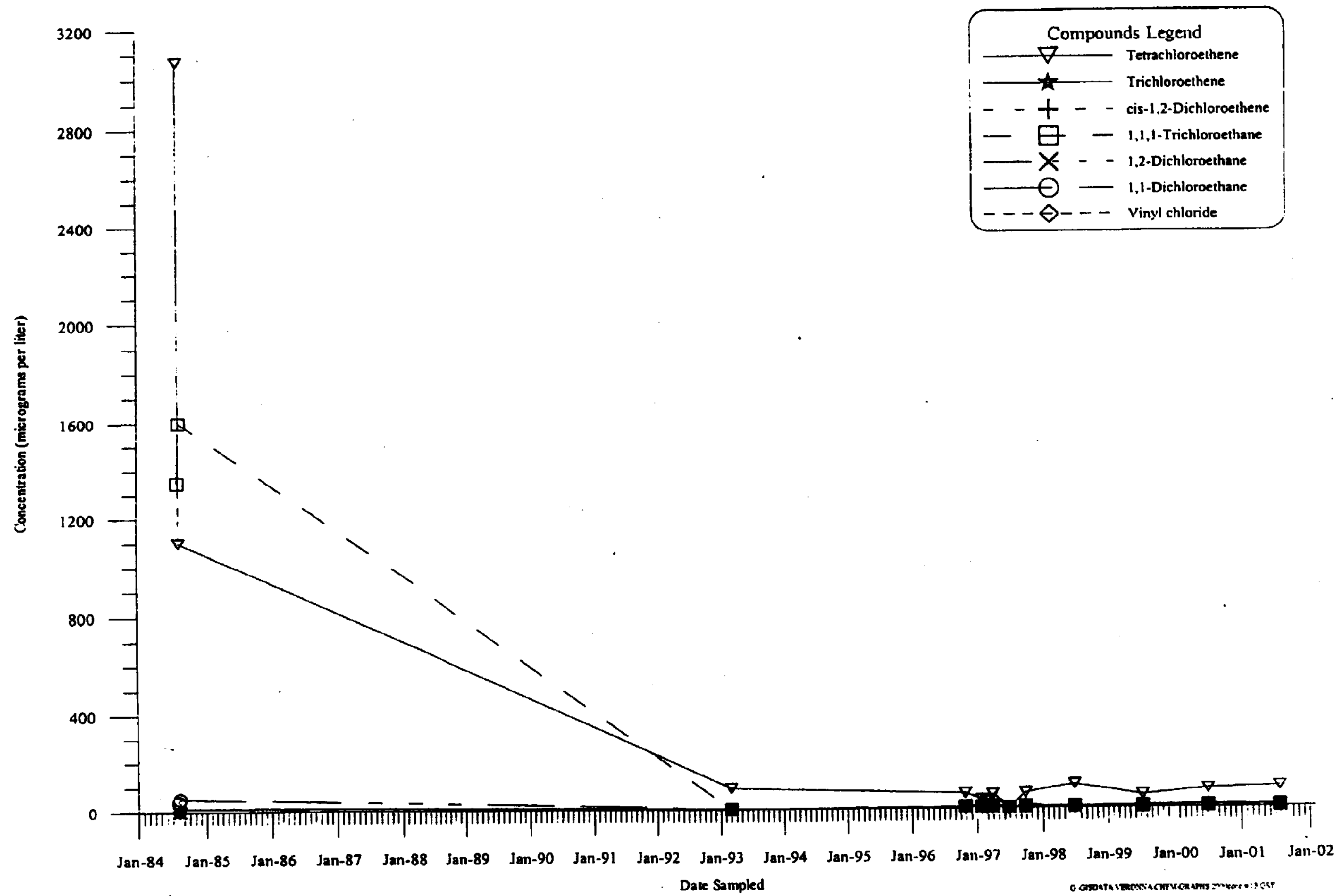


Non-detects are reported as zero.

G:\GISDATA\VERONNA\CHEM\GRAPHS\2000conc\ch146i.GRF

Concentration of Compounds Detected in Well CH-146I at the Veronna Well Field Site through August 2001

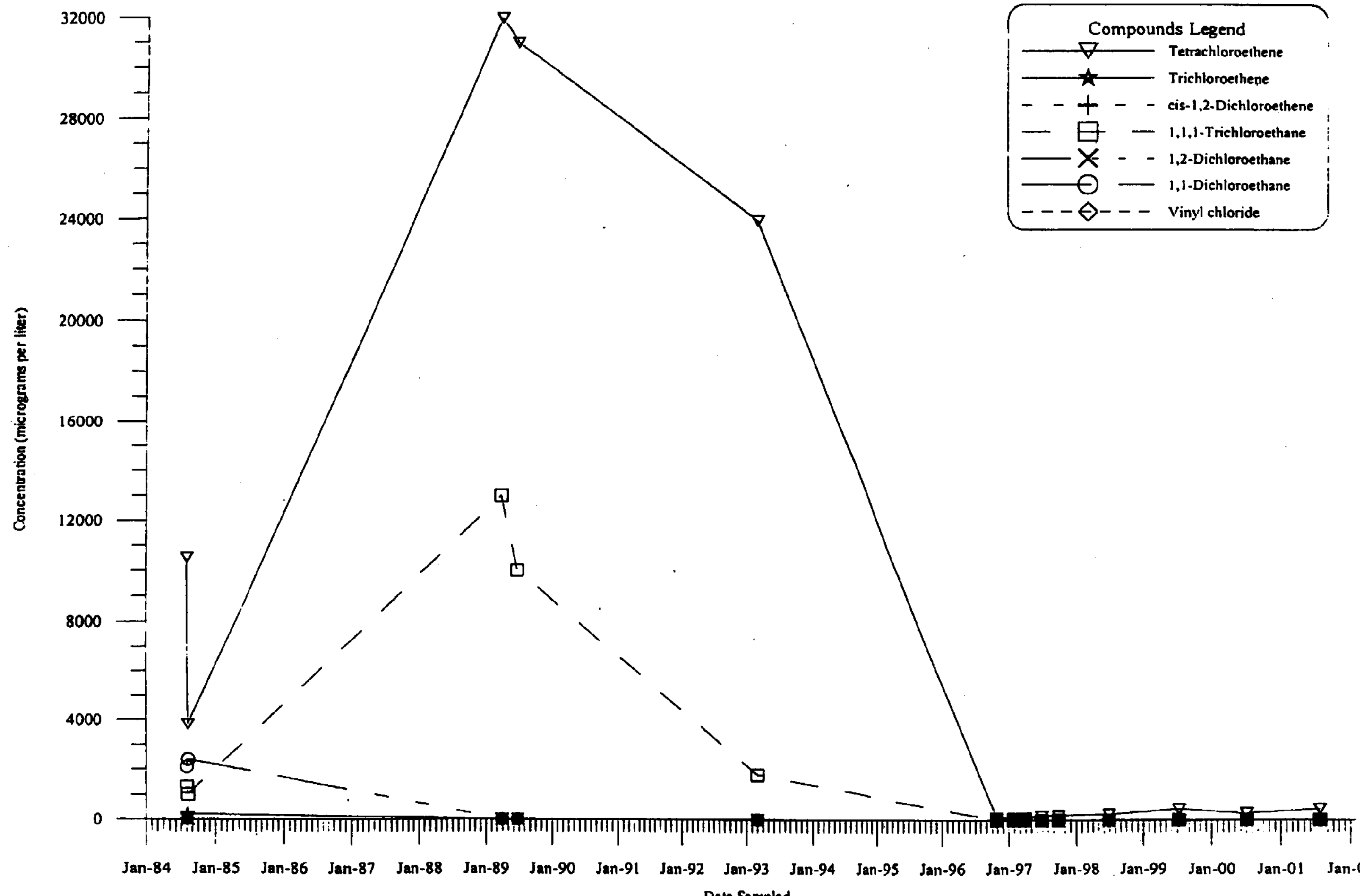
FIGURE
42



Non-detects are reported as zero.

Concentration of Compounds Detected in Well W-13 at the Veronna Well Field Site through August 2001

FIGURE 43



Non-detects are reported as zero.

Concentration of Compounds Detected in Well W-14 at the Veronna Well Field Site through August 2001

FIGURE 44

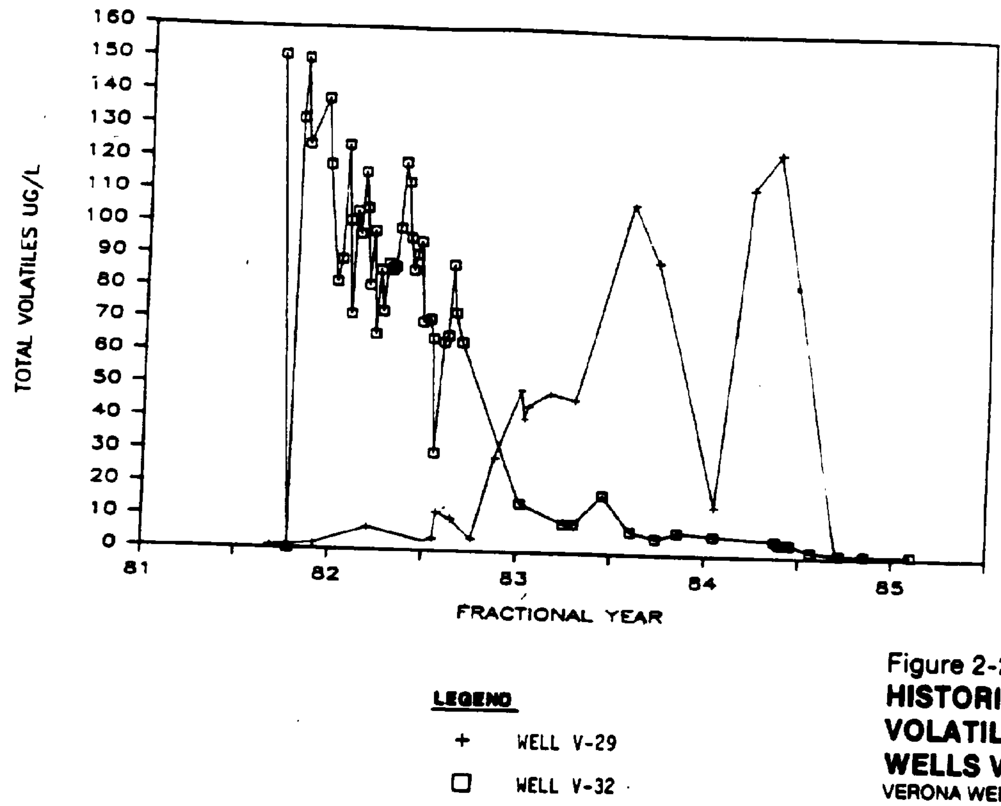
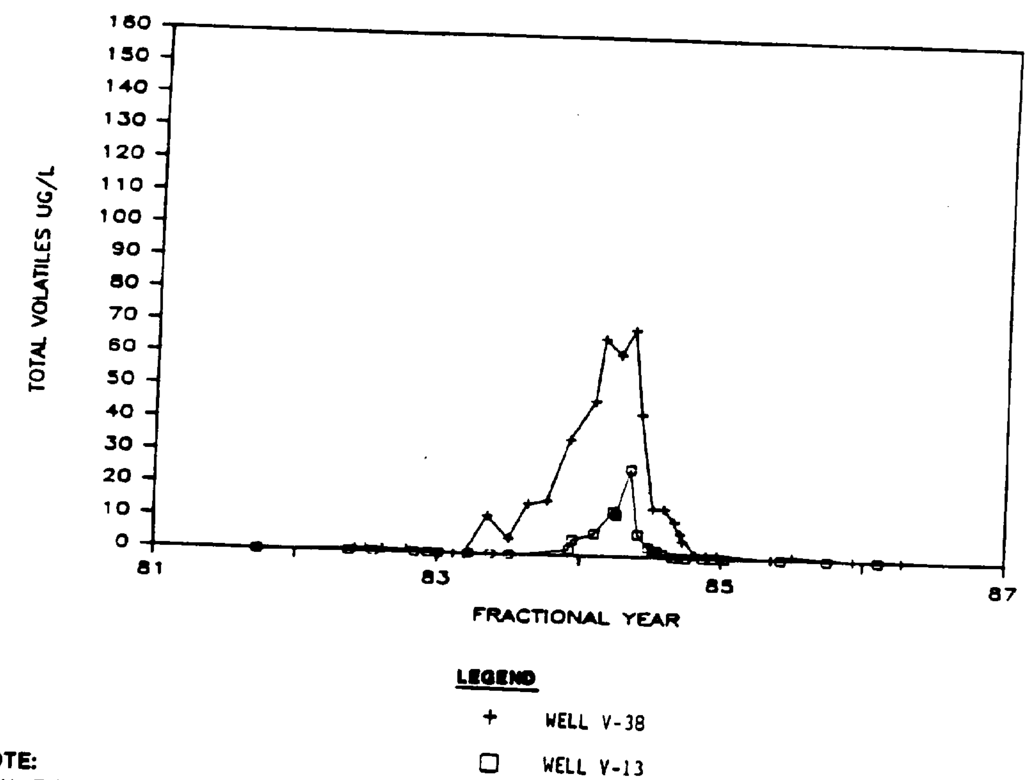


Figure 2-2
HISTORIC TOTAL VOLATILE ORGANICS WELLS V-29 AND V-32
VERONA WELL FIELD
BATTLE CREEK, MICHIGAN



NOTE:
ANALYTICAL DATA IS FROM VERONA WELL FIELD WATER QUALITY SUMMARY (In appendixes to *Draft Remedial Investigation, Verona Well Field, Battle Creek, Michigan.* Warzyn, August 29, 1986)

Figure 2-3
HISTORIC TOTAL VOLATILE ORGANICS WELLS V-13 AND V-38
VERONA WELL FIELD
BATTLE CREEK, MICHIGAN

Table H-1. Summary of Water Quality Results for City Production Wells and Plant Tap (provided by City of Battle Creek), Verona Well Field Superfund Site, Battle Creek, Michigan.

Sample ID Sample Date	V13 2/9/89	V13 4/6/89	V13 3/5/90	V13 8/21/90	V13 5/21/91	V13 7/16/91	V13 3/17/92	V13 2/11/97	V13 5/13/97	V13 8/19/97	V13 11/18/97
Parameter (mg/L)											
cis-1,2-DCE	0.0005	0.0012	ND	0.0005	0.0006	0.0006	0.0008	0.0007	0.0005	0.0005	0.0007
1,1-DCA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Trihalomethanes	ND	ND	1	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Footnotes on last page.

Table H-1. Summary of Water Quality Results for City Production Wells and Plant Tap (provided by City of Battle Creek), Verona Well Field Superfund Site, Battle Creek, Michigan.

Sample ID	V13	V13	V13	V13	V13	V13	V13
Sample Date	2/17/98	8/18/98	2/16/99	7/12/99	11/16/99	5/16/00	11/14/00
Parameter (mg/L)							
cis-1,2-DCE	0.0006	ND	ND	ND	ND	ND	ND
1,1-DCA	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND
Total Trihalomethanes	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	0.0009	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND

Footnotes on last page.

Table H-1. Summary of Water Qaulity Results for City Production Wells and Plant Tap (provided by City of Battle Creek), Verona Well Field Superfund Site, Battle Creek, Michigan.

Sample ID	V36	V36	V36	V36	V36	V36	V36	V36	V36	V36	V36	V36	V36
Sample Date	7/13/88	7/29/88	8/22/88	1/30/89	2/9/89	4/6/89	12/4/89	12/27/89	7/24/90	9/18/90	6/18/91	8/20/91	12/17/91
Parameter (mg/L)													
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-DCE	0.0001	0.0007	0.001	0.0009	0.0006	0.0007	0.002	0.002	0.0014	0.0012	0.0008	0.0012	0.0005
1,1-DCA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Trihalomethanes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Footnotes on last page.

Table H-1. Summary of Water Qaulity Results for City Production Wells and Plant Tap (provided by City of Battle Creek), Verona Well Field Superfund Site, Battle Creek, Michigan.

Sample ID	V36	V36	V36	V36	V36	V36	V36	V36	V36	V36	V36
Sample Date	11/12/96	2/11/97	5/13/97	8/19/97	11/18/97	5/19/98	11/30/98	5/18/99	7/12/99	2/15/00	7/18/00
Parameter (mg/L)											
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	0.0005	ND	ND
cis-1,2-DCE	0.005	0.0031	0.0019	0.002	0.0016	0.0015	0.0007	0.0022	0.0022	0.001	0.0005
1,1-DCA	0.0014	0.0007	0.0005	ND	0.0006	ND	ND	0.0005	0.0005	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	trace	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	trace
Total Trihalomethanes	trace	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	0.0004	trace	trace	ND	ND	trace	ND	ND	ND	ND	ND
Vinyl Chloride	0.0009	0.0005	trace	ND	ND	trace	ND	ND	ND	ND	ND

Footnotes on last page.

Table H-1. Summary of Water Quality Results for City Production Wells and Plant Tap (provided by City of Battle Creek), Verona Well Field Superfund Site, Battle Creek, Michigan.

Sample ID Sample Date	V14 All (thru 5/16/00)	V15 All (thru 2/16/99)	V15 05/18/1999	V15 02/15/2000	V15 07/18/2000	V17 All (thru 11/16/99)	V17 11/14/2000
Parameter (mg/L)							
cis-1,2-DCE	ND	ND	trace	ND	ND	trace	ND
1,1-DCA	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	0.001	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	trace	ND	ND	ND
Total Trihalomethanes	ND	ND	0.001	ND	ND	ND	ND
Toluene	ND	ND	ND	0.0005	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND

Footnotes on last page.

Table H-1. Summary of Water Quality Results for City Production Wells and Plant Tap (provided by City of Battle Creek), Verona Well Field Superfund Site, Battle Creek, Michigan.

Sample ID Sample Date	V38 07/19/2000	V39 All (thru 11/14/00)	V40 All (thru 11/14/00)	V41 All (thru 2/15/00)	V41 07/18/2000	V51 All (thru 5/16/00)	V52 All (thru 7/18/00)	V53 All (thru 11/14/00)
Parameter (mg/L)								
cis-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DCA	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	0.0009	ND	ND	ND	0.0004	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND
Total Trihalomethanes	0.0009	ND	ND	ND	0.0004	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND

Footnotes on last page.

Table H-1. Summary of Water Qaulity Results for City Production Wells and Plant Tap (provided by City of Battle Creek), Verona Well Field Superfund Site, Battle Creek, Michigan.

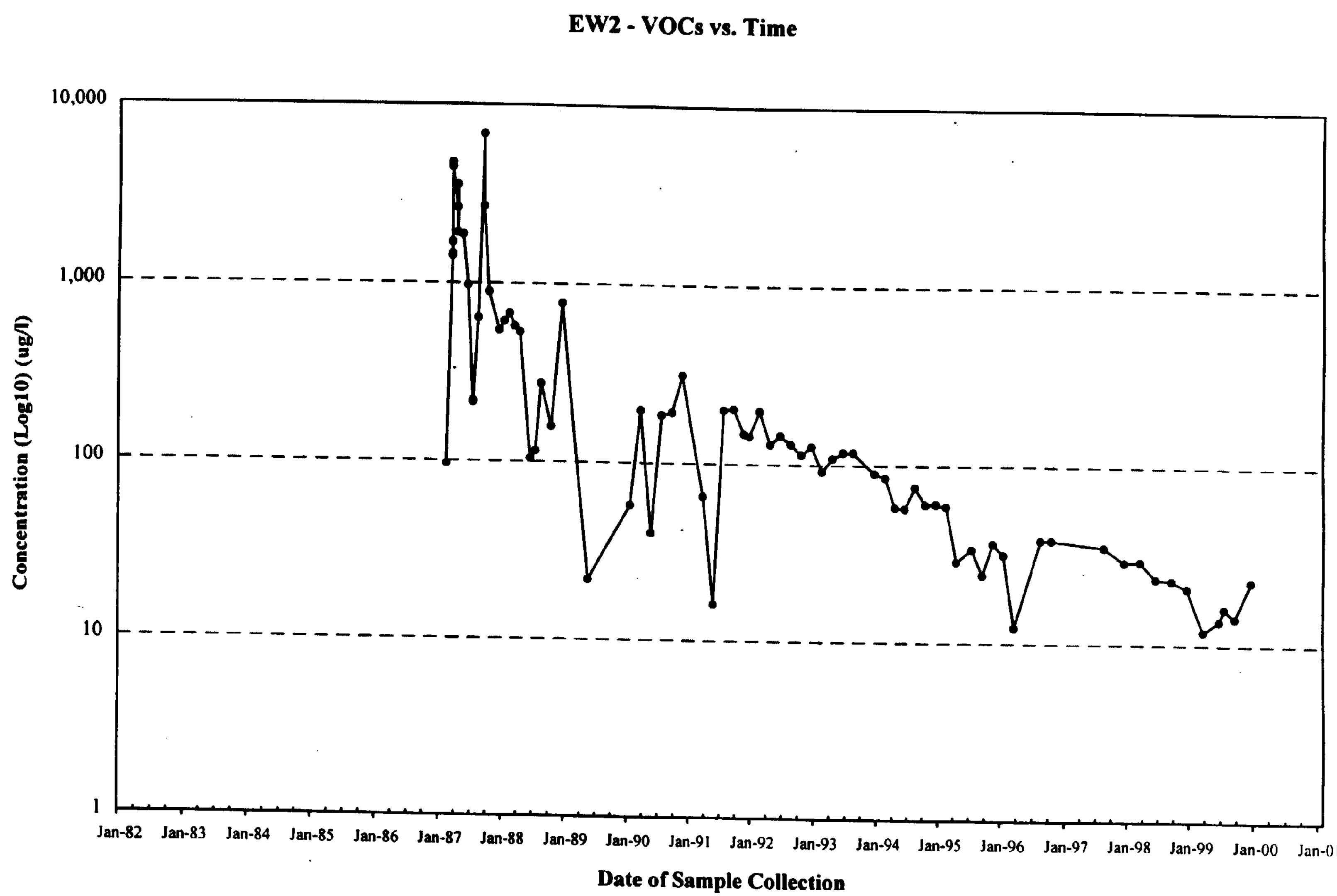
Sample ID	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap
Sample Date	4/11/88	7/13/88	10/10/88	1/17/89	2/9/89	4/6/89	5/8/89	6/5/89	8/21/89	12/4/89	3/5/90	4/11/90	5/22/90	6/26/90
Parameter (mg/L)														
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DCA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Trihalomethanes	18	22	21	27	21	27.4	30	41	27	17	24	8	8	6.3
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Footnotes on last page.

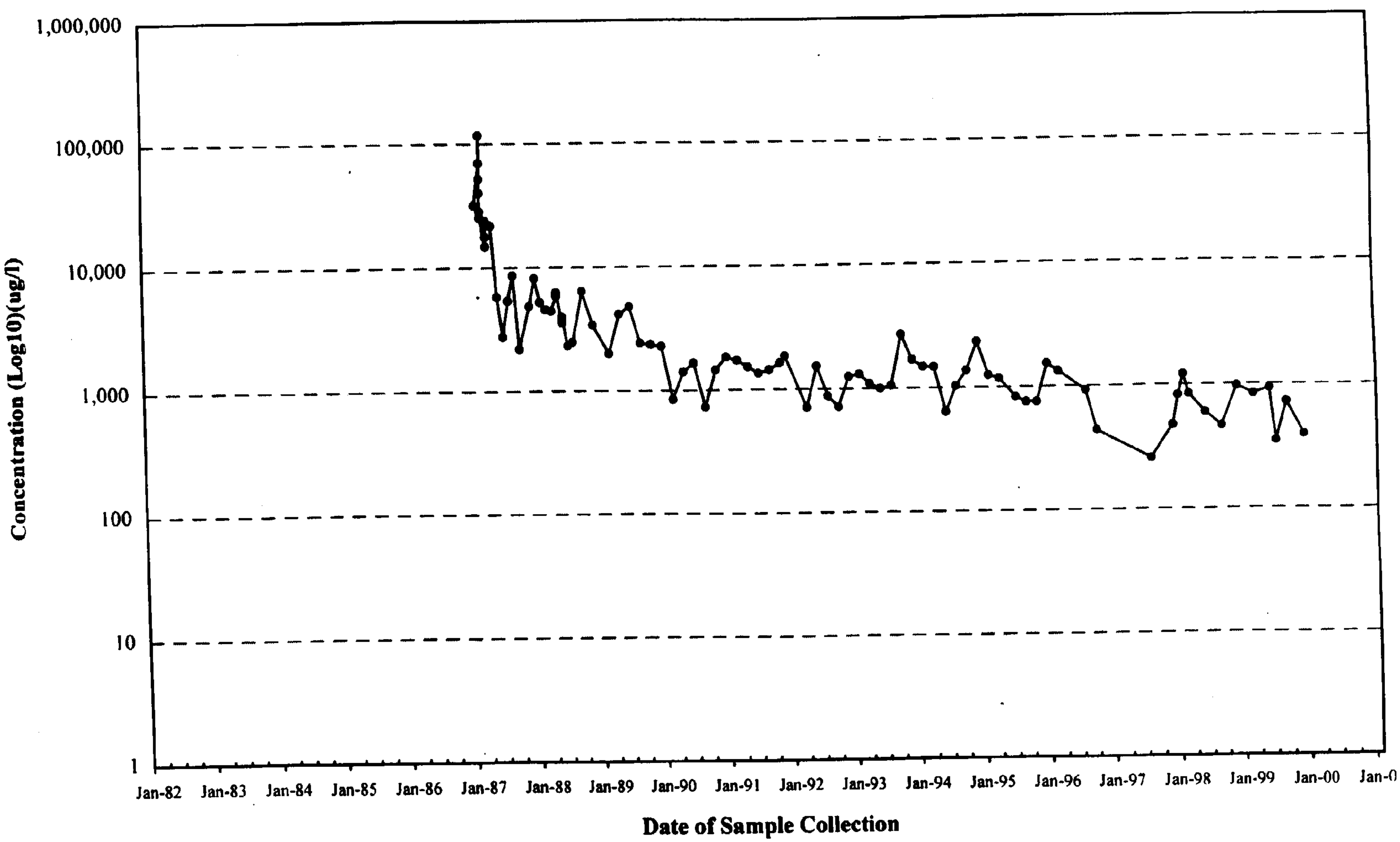
Table H-1. Summary of Water Qaulity Results for City Production Wells and Plant Tap (provided by City of Battle Creek), Verona Well Field Superfund Site, Battle Creek, Michigan.

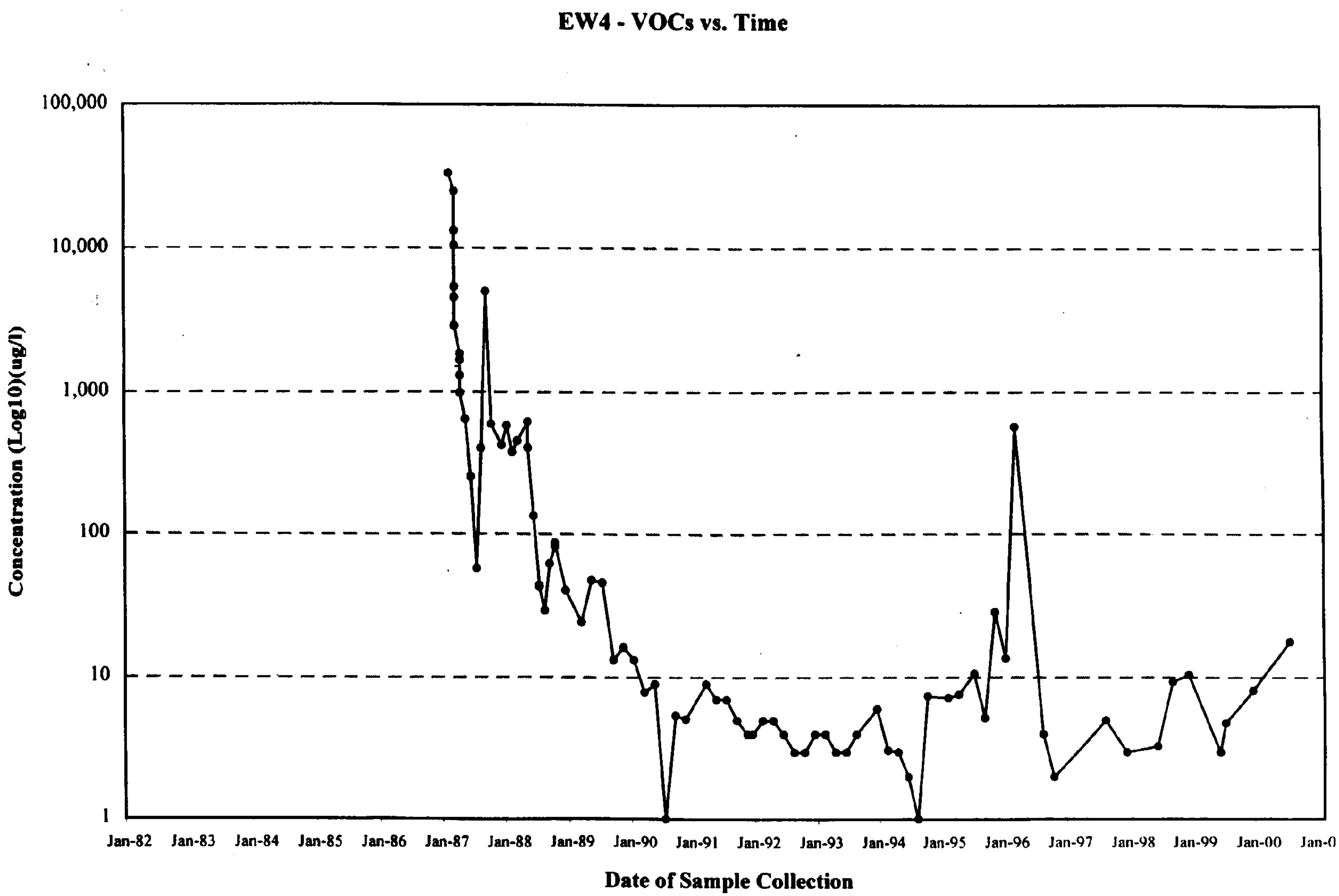
Sample ID	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap	Plant Tap
Sample Date	7/24/90	8/21/90	8/19/90	12/4/90	5/21/91	6/18/91	7/16/91	8/20/91	9/17/91	12/17/91	3/17/92	6/16/92	9/15/92	12/17/92
Parameter (mg/L)														
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DCA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Trihalomethanes	28.3	9.4	22.4	4	7.4	18.2	8.8	19.9	9.5	17.2	ND	22.9	22.5	7.5
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Footnotes on last page.

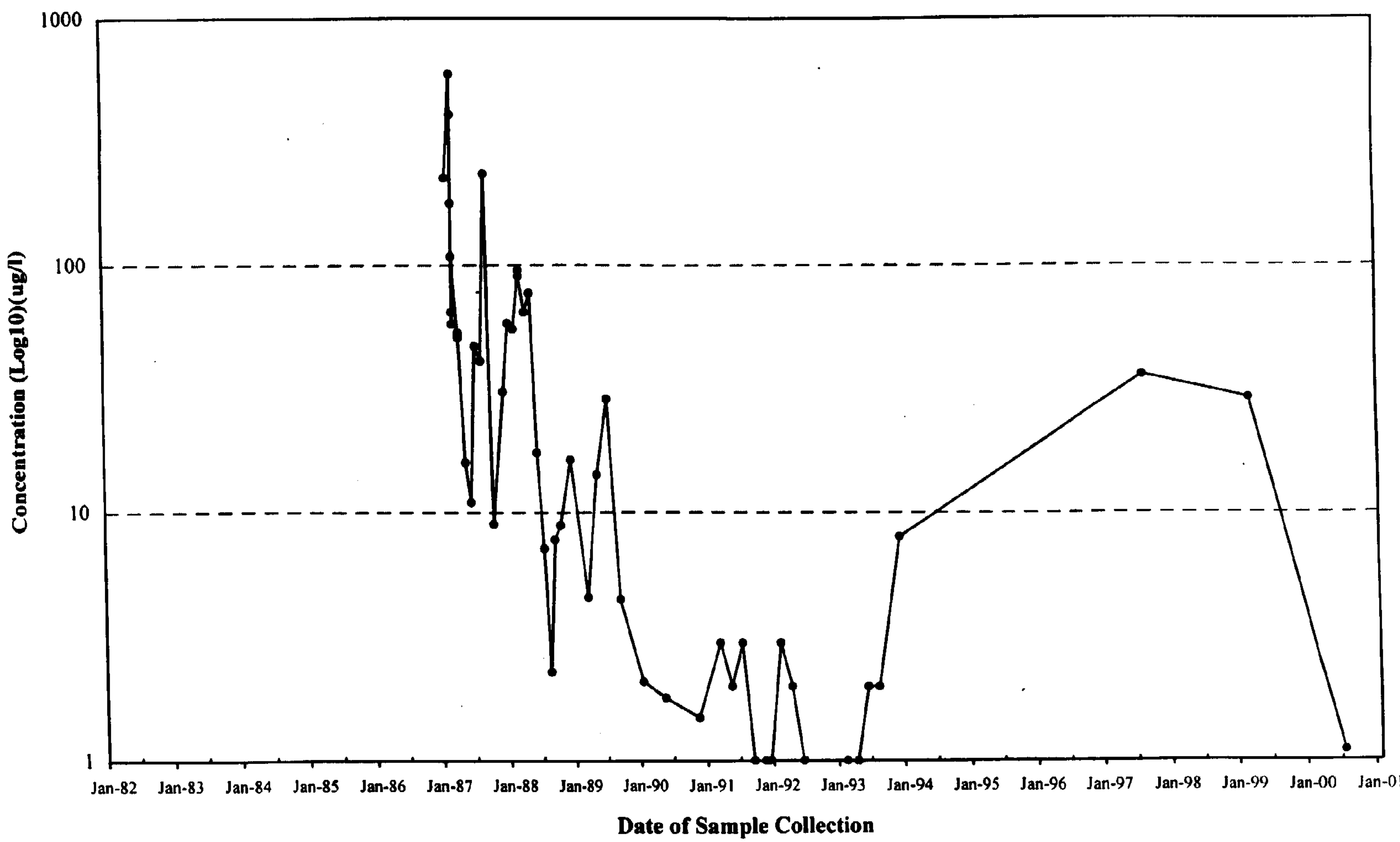

EW2 - VOCs vs. Time
Concentration (Log10) (ug/l)
10,000
1,000
100
10
1
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Date of Sample Collection

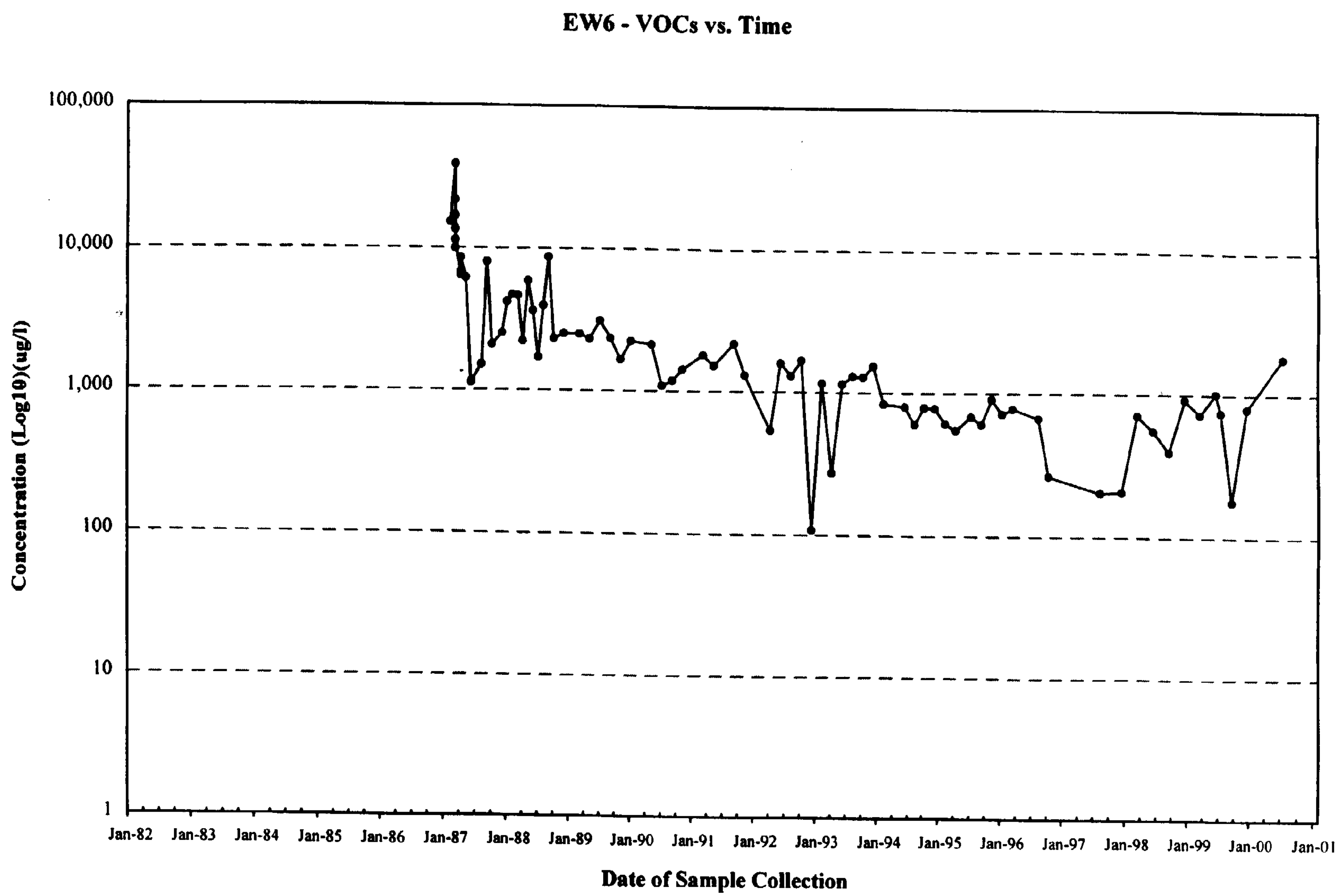
EW3 - VOCs vs. Time



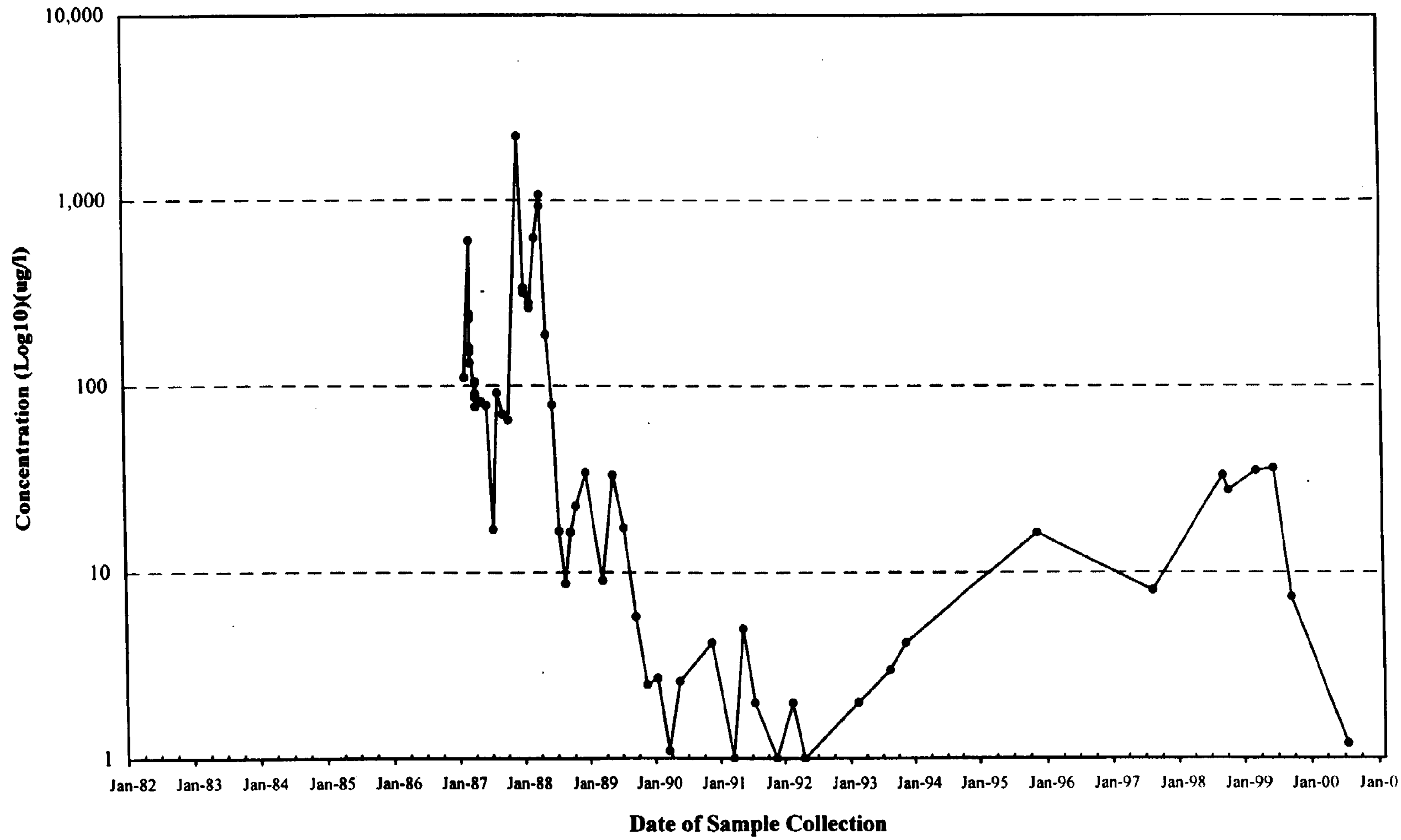

EW4 - VOCs vs. Time
Concentration (Log10)(ug/l)
100,000
10,000
1,000
100
10
1
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Date of Sample Collection

EW5 - VOCs vs. Time

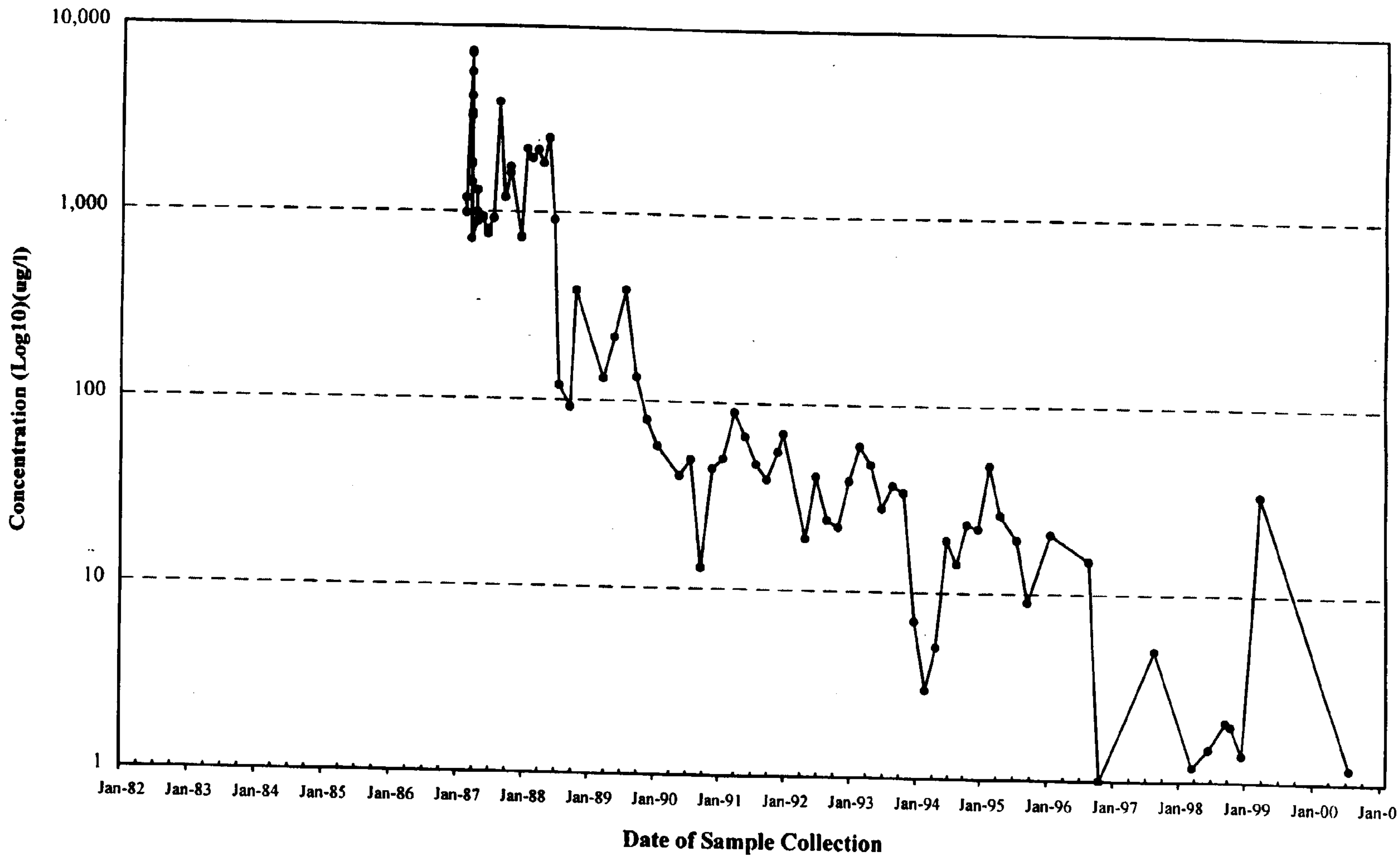



EW6 - VOCs vs. Time
Concentration (Log10)(ug/l)
100,000
10,000
1,000
100
10
1
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Date of Sample Collection

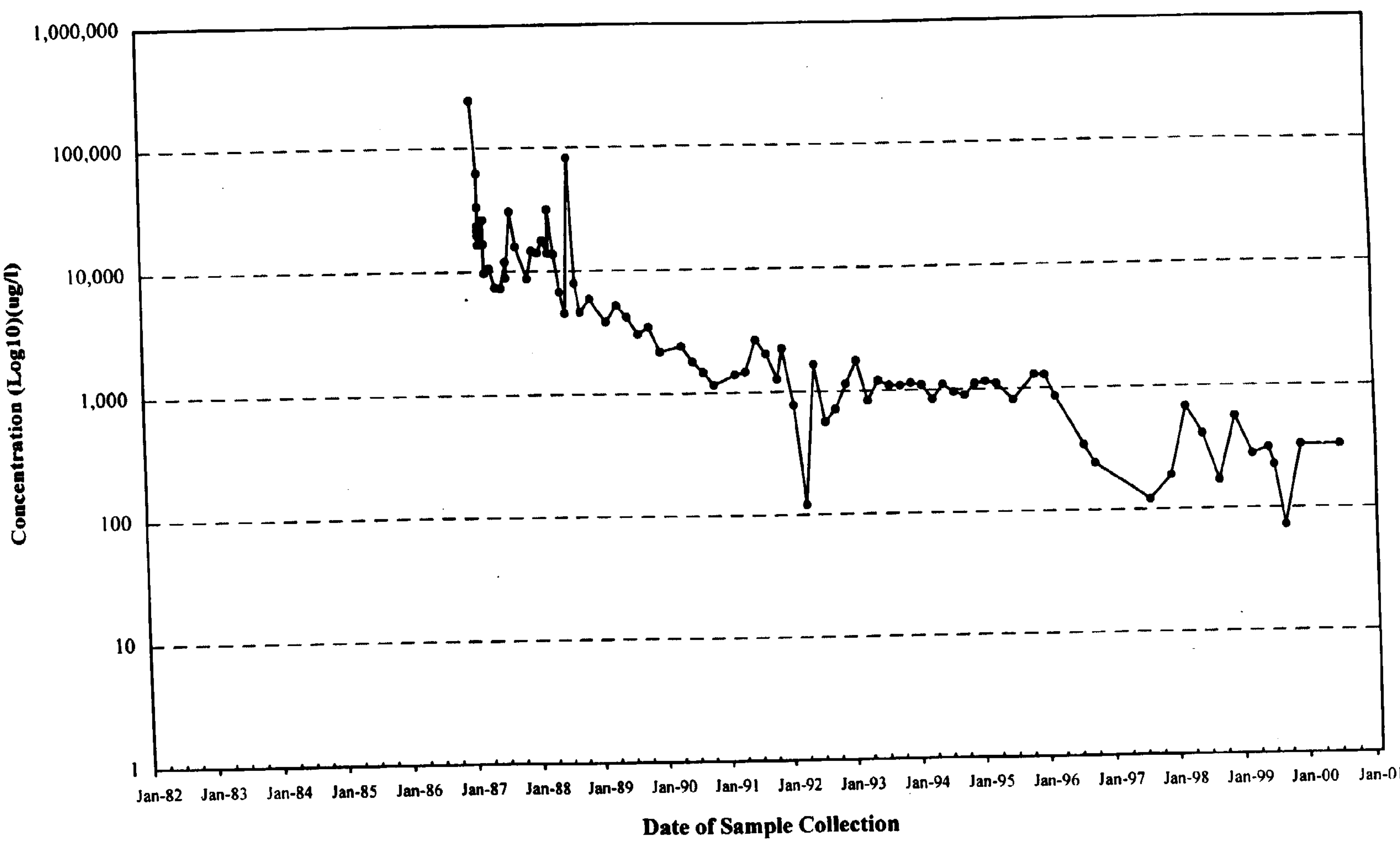
EW7 - VOCs vs. Time



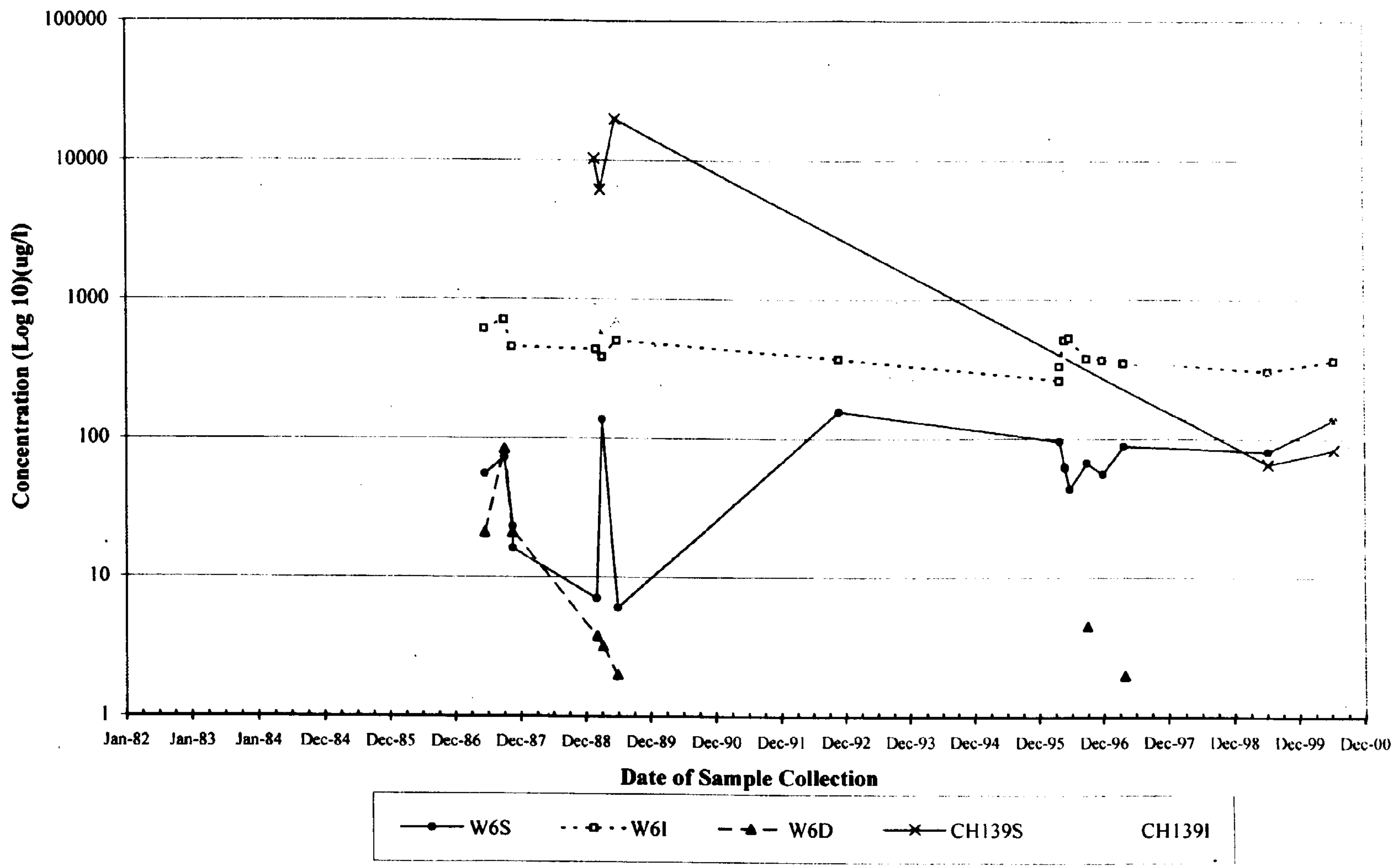
EW9 - VOCs vs. Time



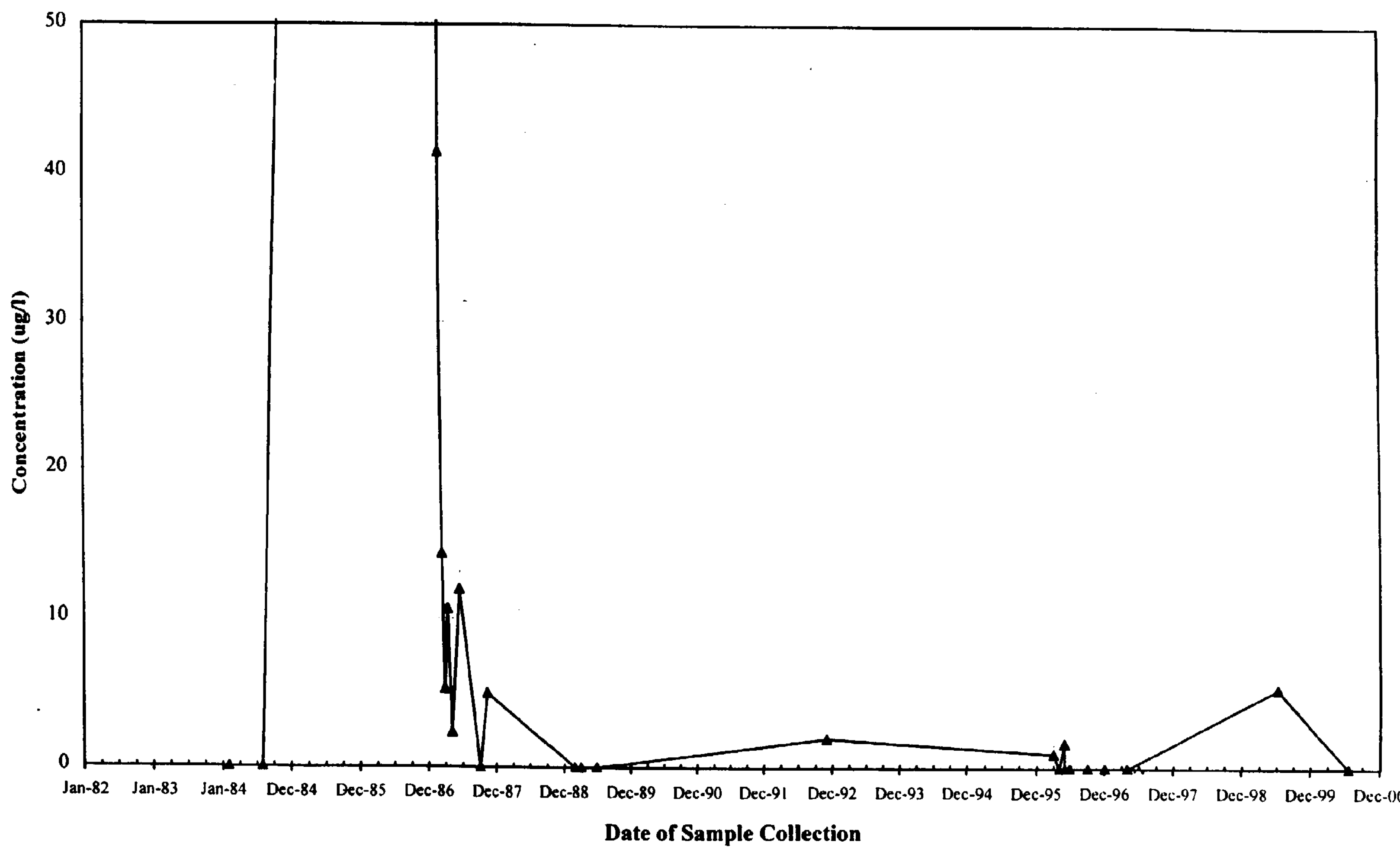
EW8 - VOCs vs. Time

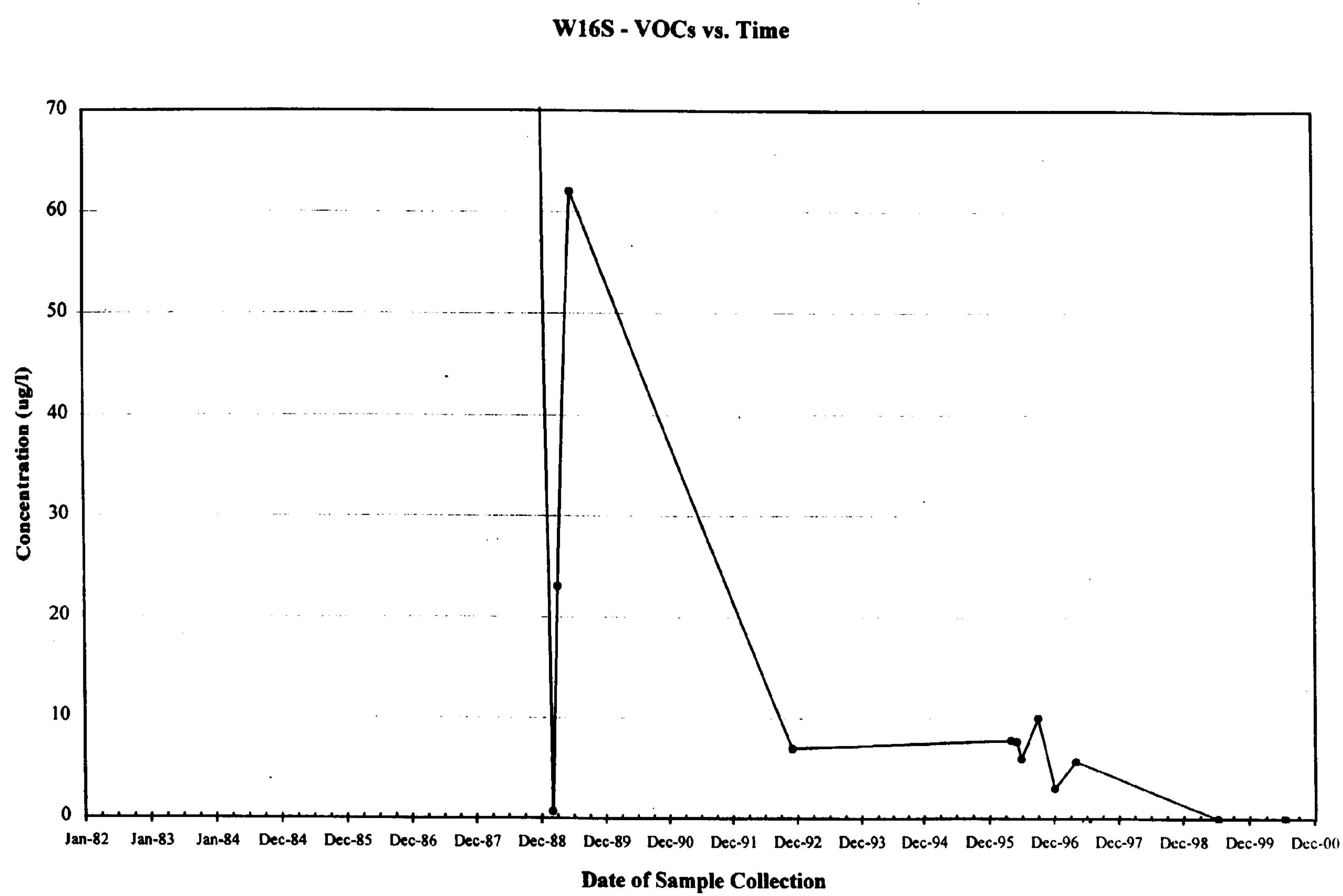


W6S, W6I, W6D, CH139S, and CH139I - VOCs vs. Time



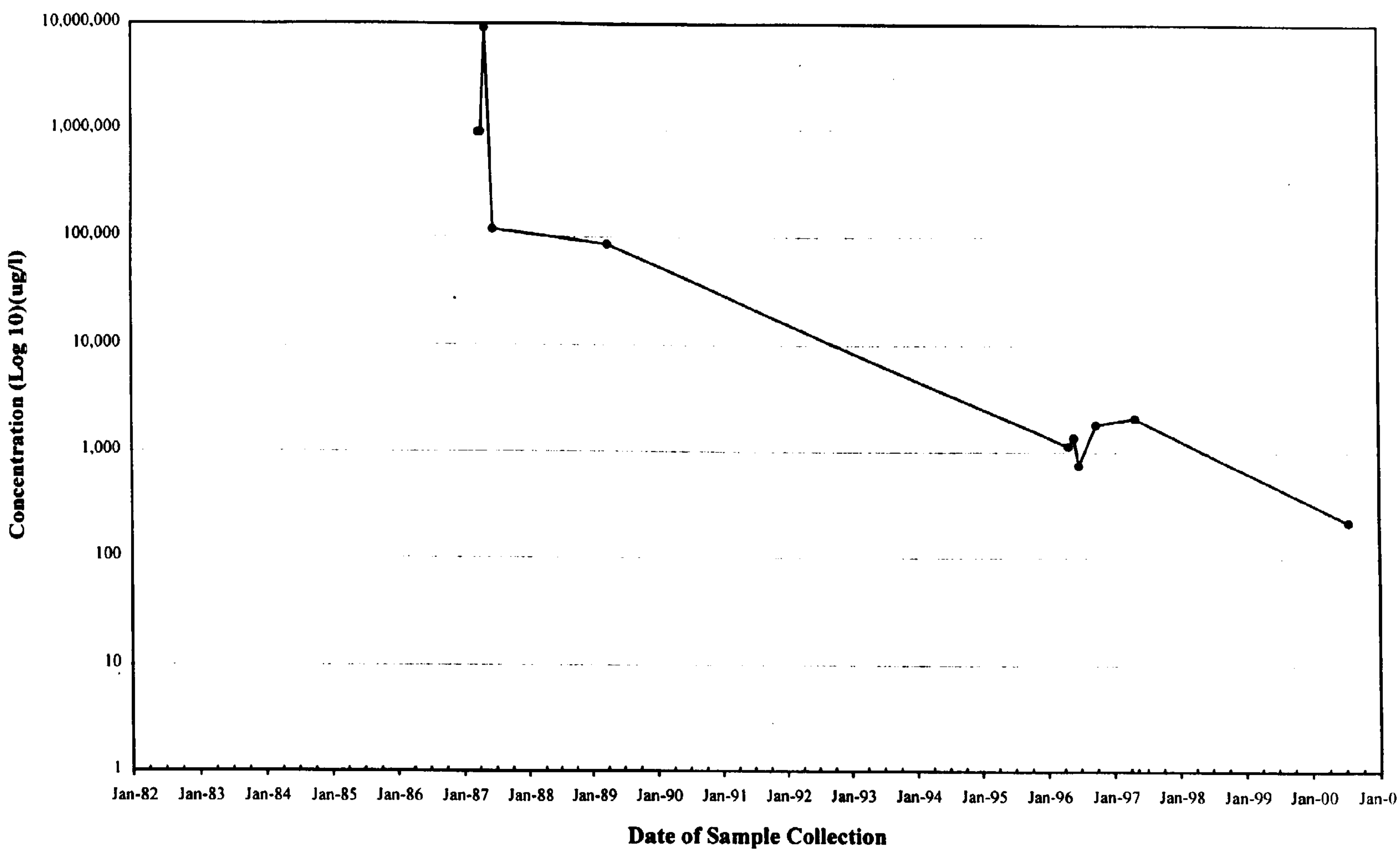
W10I - VOCs vs. Time

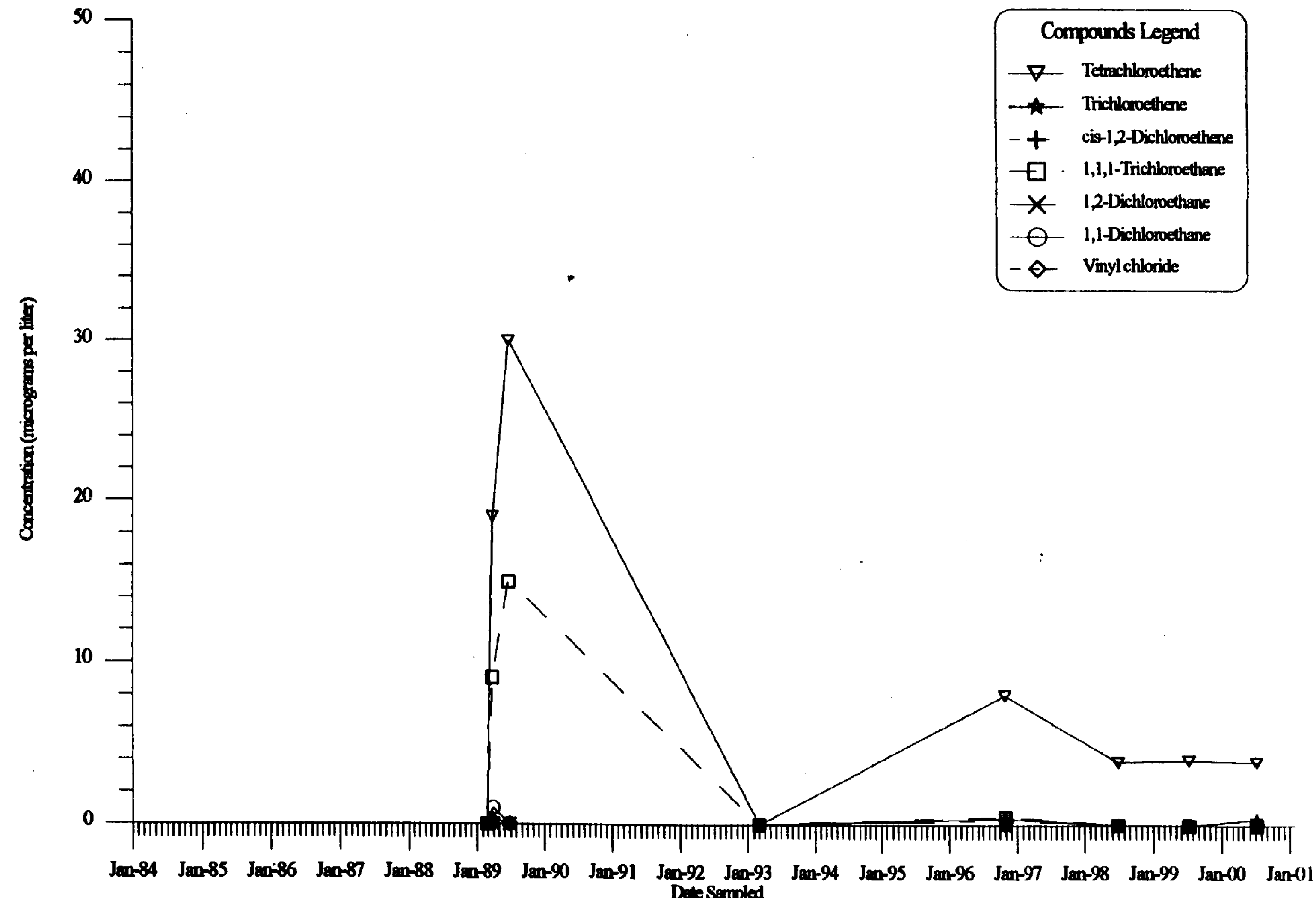




W16S - VOCs vs. Time
Concentration (ug/l)
0
10
20
30
40
50
60
70
Jan-82
Jan-83
Jan-84
Dec-84
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Date of Sample Collection

B18S - VOCs vs. Time

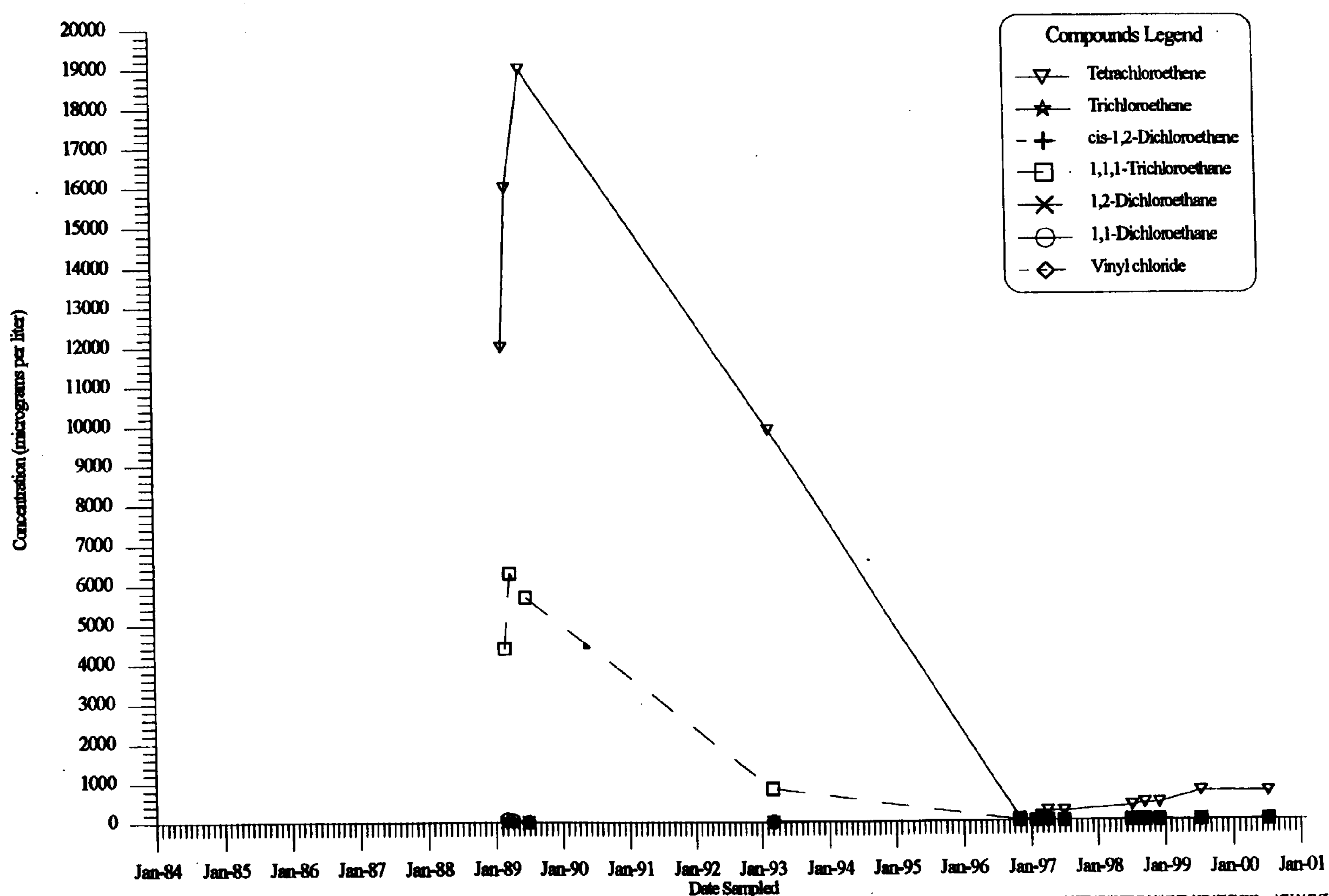




Non-detects are reported as zero.

Concentration of Compounds Detected in Well CH-141 at the Veronna Well Field Site through July 2000

FIGURE 27



Non-detects are reported as zero.

Concentration of Compounds Detected in Well CH-145 at the Veronna Well Field Site through July 2000	FIGURE 28